Historic Preservation & Energy Efficiency

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Executive Summary

The City of Washington and its Historic Preservation Commission (HPC) wish to advise residents on possible solutions to escalating utility prices and energy use in historic properties. Following a comparative analysis of the guidelines set forth by several HPCs throughout North Carolina and the review of related case studies, it is evident that improving energy usage in historic buildings need not require – though it may allow for – significant modifications to the property.

Historic properties may employ a number of both passive (such as operational measures and maintenance and/or repair of current architectural features) and more active measures (such as the installation of renewable energy systems). By utilizing, maintaining and preserving the architectural elements present, property owners can substantially decrease energy consumption without significant damage to the building and without considerable cost that may accompany an energy retrofit plan. Similarly, property owners should consider the use of a renewable technology system, such as solar collectors or wind turbines. Though these systems do not improve energy consumption overall, they do derive energy from a renewable source further decreasing the use of non-renewable energy sources, such as petroleum or coal.

It is recommended that the City of Washington and its HPC encourage the utilization and maintenance of inherent energy saving features found on historic properties. Doing so would represent an understanding of both the importance of historic preservation as well as the energy investment that has already been made in the procurement and manufacturing of the buildings. Several other historic communities in North Carolina have adopted similar guidelines. It is also recommended that the City and HPC use these as examples in its production of similar guidelines for both energy efficiency and renewable technologies.

As evidenced by this research and comparison of the guidelines enacted by several communities throughout North Carolina, expensive and substantial alterations of are not necessary to improve energy efficiency in historic properties. Simple, non-evasive steps taken through proper maintenance and repair can result in considerable energy savings. Similarly, if need be, more active, introduction of renewable energy technologies may be introduced without significantly altering the property or district.

Table of Contents

[1] Mechanical systems will refer to those systems that are not traditional historic features such as air conditioning units or HVAC systems.

Tables display examples of how other HPCs have included specific standards into its Historic Preservation Guidelines. The first column on these tables is representative of a guideline or some variation of a guideline. The latter columns reference a specific Historic Preservation District. An "X" within, indicates that the specific HPC has incorporated some variation of the guideline into its Handbook.

Historic Preservation & Energy Efficiency

1. Introduction

With ever-increasing prices in non-renewable energy resources, citizens are faced with the burden of having to pay for these increases while the demand remains. This burden is especially apparent for those who own historic properties, which have obtained a reputation of being energy inefficient. In addition to being labeled energy inefficient, many historic property owners are perceived to be constrained by guidelines enforced by their local Historic Preservation Commissions (HPC). These guidelines include the Secretary of Interior's *Standards for Rehabilitation* of historic properties (the *Standards* provide brief, general guidelines as opposed to specific advice) as well as specific standards set forth by the local commission.[2]

This document is a resource for the City of Washington's Historic Preservation Commission (HPC) as it re-designs its *Historic District Design Guidelines* to include provisions for energy-retrofit and emerging technology, as well as emphasize the utilization of the inherent energy efficient features found in historic buildings. Historic buildings may be made more energy efficient by incorporating things such as utilization of passive measures, preservation retrofitting, as well as more progressive energy saving measures such as solar and wind turbines. This document also provides examples of financing energy/preservation retrofits by way of tax incentives and energy mortgages. Other North Carolina HPC provisions for energy retrofit, as well as case studies from other states provide additional guidance for the City of Washington's HPC. The recommendations and alternatives presented are mindful that they are being presented for a preservation district and that maintaining the historic and architectural integrity of the district may be a limiting factor while finding viable solutions for improved energy performance.

2. Passive Measures to Promote Energy Efficiency in Historic Buildings

The old adage that "things just are not built the way they used to be" is one that holds firm in the realm of historic properties. At the same time, with the progression of new technologies, citizens have become accustomed to a lifestyle dependent on the use of non-renewable resources to enhance the comfort of their homes with electricity and systems that allow for them to heat or cool their houses to a desired level of luxury. This comfort does not come without a cost to the consumer or the environment. Many people respond to this dilemma by suggesting replacement of existing buildings with those that are considered to be "green"; however, it can be argued that the "greenest building is the one already built." Existing buildings, including historic buildings represent an energy investment that has already been expended in the procurement, manufacture and transport of materials and the construction process itself. The demolition of an existing building to build a new "green" building in its place may be counter-

[2] Acknowledgement for the advice, comments and opportunity by: the City of Washington, NC, the Historic Preservation Commission, the Historic Preservation Commission's subcommittee for redesigning the Guidelines, Bianca Gentile, John Rodman, Dr. Robert Thompson, John Wood, Nick Bailey, Chris Baker & Jessica Selby.

productive to the concept of energy conservation. By some estimates, it would take over 65 years to recoup the energy savings of demolishing an existing building and replacing it with a new "green" building.[3]

In regard to historic properties, there are several passive measures that can be introduced to help curb this dependency on non-renewable resources while maintaining the same level of comfort for the owner.[4] Passive measures may come at little to no cost to the property owner, while simultaneously preserving the historic integrity of the building. Historic buildings utilize older technology, but can still use energy more efficiently than buildings built more recently. For example, the United States General Services Administration, which is the single largest property owner in the nation, completed energy audits on its buildings and found that the utility costs associated with historic buildings were, on average, 27% less than those costs in more modern buildings.[5] They use less energy because they were built with a well-developed sense of physical comfort and because they maximized the natural sources of heating, lighting and ventilation. The historic building owner should understand these inherent energy-saving qualities.[6] Utilization and maintenance of the inherent energy saving features found throughout the historic property will lead to a reduction of long-term costs to the owner and the environment.

The following paragraphs discuss *how* and *what* features can be used to address these issues, as well as examples of how other HPCs across North Carolina have incorporated these standards into their Guidelines. For example, the design guidelines for Montford, Wilmington, Raleigh, Hillsborough and Washington require that historic property owners "Retain and preserve the inherent energy conserving features of historic buildings and their sites, including shade trees, porches, awnings, operable windows, transoms, shutters and blinds." This is a statement that emphasizes the use of traditional features found on historic properties. Doing so enhances sustainability and may result in reduced energy costs for the homeowner.

At current, the City of Wilson's Historic Property Owners Handbook with Design Guidelines for Local Historic Districts and Local Landmarks is the only one the nine guidelines researched that provides a section dedicated to "Design Guidelines for Sustainability and Energy Retrofit." Figure 1 dictates the contents of these guidelines. As will be later illustrated, "Sustainability and Energy Efficiency" guidelines pertain not only to emerging technologies but also to traditional features found on historic buildings. This section of Wilson's HPC Guidelines is provided as an example of how and why certain features of a building can contribute to overall energy efficiency while simultaneously maintaining the buildings historic character.

[3] Cheltenham Township. *Historic preservation and sustainability*. Retrieved from http://www.cr.nps.gov/hps/hpg/downloads/Sustainability-brochure_Cheltenham.pdf
[4] Cheltenham Township
[5] Cheltenham Township
[6] Smith, B. A. (1978). Conserving energy in historic buildings. In Matthai, R. A. (Ed.). Energy conservation and historic preservation: a resource booklet. (pp.3-10).

Figure 1: Design Guidelines for Sustainability and Energy Efficiency (Wilson, NC)

1. Identify and preserve the historic energy efficient features of the historic building and district.
2. Maintain energy efficient features in an operable state. If non-operable, repair to a state of utility.
3. It is appropriate to preserve and maintain historic storm and screen doors.
4. It is appropriate to increase efficiency of a historic building by using weather-stripping, caulking and installing storm windows and doors. Storm doors and windows must maintain a narrow profile so that the character-defining features are not obscured. The dividing bar of the storm window must match the dividing bar on the window. Finish storm windows to match the color of the sash, trim, or in white. Installation of storm windows shall not require the removal of trim. Storm doors shall be full view and align with the stiles and rails of the door. Select storm and screen door designs that do not obscure the exterior door or its details.
5. Awnings or shutters over window, door and porch openings may be appropriate if physical or documentary evidence exists to support their historical use. Ensure installation does not damage the historic fabric or architectural details of the building.
6. It is appropriate to install new mechanical systems with minimal alteration to the exterior of the building as well as the character-defining features of the interior.
7. It is appropriate to insulate the roof or attic floor in order to increase energy efficiency.
8. It is inappropriate for "green" roof designs to compromise historic materials, features and details of the historic building or district.
9. Alternative energy source equipment such as freestanding solar panels and wind turbines must be appropriately sited in the secondary or tertiary Areas of Visual Concern (AVC) and screened from public view.
10. It is inappropriate to locate skylights, solar collectors, ventilators or other mechanical equipment on rooftops in the primary area of visual concern. Flat skylights and solar panels are appropriate on the rear slopes of the roof provided they are not visible from the public right-of-way. Solar shingles may be an appropriate alternative provided they are consistent with the roofing guidelines.
11. Install cisterns, rain barrels and other water collection devices on the secondary and tertiary AVC and screen from public view.
12. When possible, use plant species that were available in Wilson during the district's period of significance. Plant shade trees on the south and west sides of the building and conifer/pine wind breaks on the north side of the building.
13. Consult the Preservation Planner or Eastern Office of Archives and History with specific questions about energy efficiency and historic buildings.

Note: Information in the above figure was retrieved from the Historic District Guidelines of Wilson, NC.

2.a. Operational controls.

Utilizing the operational controls refers to *how* and *when* a building is being used. Because operational measures do not have a visual impact on the building's façade, they are not subject to HPC restrictions. It is left to the owner's discretion to minimize the use of energy; however, the HPC may encourage property owners to utilize these operational controls. Figure 2 provides examples of how an owner may reduce energy usage within a historic building.

Figure 2: Operational Controls to Help Reduce Energy Consumption in Historic Buildings

1. Lowering the thermostat in the winter (68°F), raising it in the summer (78°F – or higher)
2. Controlling the temperature in those rooms actually used
3. Reducing the level of illumination and the number of lights (maximize natural light)
4. Using operable windows, shutters, awnings and vents as originally intended to control interior environment (maximize fresh air)
5. Having mechanical equipment serviced regularly to ensure maximum efficiency
6. Cleaning radiators and forced air registers to ensure proper operation

Note: Information contained in Figure 2 was retrieved from "Conserving Energy in Historic Buildings", Baird Smith.

2.b. Trees.

Shade trees are often overlooked as a means for saving energy. Appropriate and strategically placed[7] deciduous (plants that lose their leaves each year) trees native to the area can help reduce the cost of using electrical systems throughout the year, while simultaneously preserving the historic value of a property. The leaves of the tree(s) may help reduce the intrusion of the sun into the buildings inside during the warmer months, leading to a reduction in the cost of cooling. Similarly, during the cooler months, the tree will have lost its greenery, allowing for the sun to penetrate through its branches and to assist in warming a building. Some examples of common deciduous trees found in Eastern North Carolina include apple, dogwood, fig, ironwood, magnolia, mock orange, mulberry, pecan, Rose-of-Sharon, mimosa, white poplar, a variety of ash, crabapple and elm.

Additionally, coniferous trees may be placed on the property to act as windbreaks[8]. Having "wind breaks" may help to protect the historic features of the property from the damaging effects that winter winds may have on the building's materials and features.

[7] An example of strategically placed shade trees include those that are located on the south and west elevations of the property.

[8] Strategically placed coniferous trees and pines (to act as wind breaks) are most useful if placed on the Northern elevations of the property.

2.c. Awnings & overhanging eaves.

When historically appropriate, awnings can be introduced over windows or doors to help enhance the thermal efficiency of a historic building. In addition to improved energy performance, awnings can help reduce glare and provide rain protection over windows opened for ventilation. Table 1 demonstrates how the regulation of awnings has been used in various historic districts throughout the state. Similarly, overhanging eaves also help to control the cost of energy for the consumer. When utilized, these elements help to limit the amount of sunlight intruding into a building's interior during the summer months when the sun is high in the sky. Likewise, when the sun is lower, during the cooler months of the year, these components allow for sunlight to enter, allowing the building to warm naturally, thus reducing the need to raise the thermostat.

Table 1 Awnings

Guideline	Montford	Edenton	Beaufort	Wilmington	New Bern	Raleigh	Hillsborough	Wilson	Washington
Awnings may be installed over windows, doors, porches and storefronts where historically appropriate. Install awnings so that they do not obscure windows, doors, or other character defining features. Select awning design based on historical profiles, styles and shapes.	X	X		X		X			X
Avoid the placement of metal awnings over windows and doors. Fabric awnings may be used if the house originally or historically had them. Install awnings in such a manner that they do not conceal architectural features or damage historic building fabric. Choose colors and patterns that harmonize with the building and do not compete with it.	X		X	X	X	X	X	X	X

Note: See reference for specific source of guidelines as designated by municipality.

2.d. Paint color.

Selecting lighter color paint[9] for the exterior of a historic building will help deflect the sun's rays and heat, improving thermal efficiency. Based on historic photography, many people believe that historic buildings were originally painted white. This, however, is false. Because historic photographs are in black and white, paint samples must be taken to determine the original paint color. Studies indicate that historic buildings were originally painted a variety of colors.

[9] Examples of lighter color paint include those which are lighter hues of blue, purple, yellow, or pink (similar to that of pastels).

2.e. Porches.

Porches and their entrances are integral building features that were originally built to retain heat or block the sun and provide natural ventilation. Traditionally, porches were used as an escape for homeowners from the buildings heat, giving them a cool, shady place to relax and socialize. On historic structures, porches are typically located on the south and west elevations of the property, because the sun is hottest when facing these elevations.

2.f. Shutters.

Shutters can be used to help control sunlight. It is important for the shutters to be operable and match the size of the window opening. Depending on what is desired by the property owner, these historic features can be opened to allow for sunlight to penetrate the building's interior, creating natural light (reducing the need to use electric lights) and warm the inside of the building (reducing the need to turn up thermostats). Likewise, shutters can be closed to prevent unwanted light intrusion and help reduce cooling costs. Table 2 provides examples of how shutters have been incorporated into HPC Guidelines throughout North Carolina.

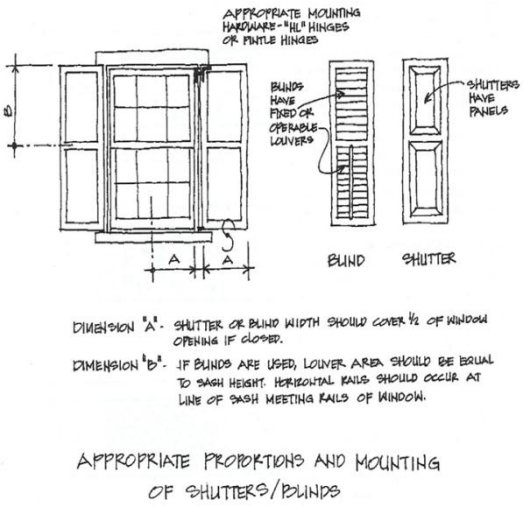

Table 2 Shutters

Guideline	Montford	Edenton	Beaufort	Wilmington	New Bern	Raleigh	Hillsborough	Wilson	Washington
Replace deteriorated or missing wooden shutters with matching new units sized to fit the opening and mounted so that they can be opened. It is not appropriate to introduce shutters on a historic building if no evidence of earlier shutters exists.	X	X	X	X		X	X	X	X
If deteriorated or missing shutter must be replaced due to deterioration, replace it with a shutter that matches the original in size, shape, design, scale, color, craftsmanship and material. It should be operable.	X	X			X				

Note: See reference for specific source of guidelines as designated by municipality.

2.g. Storm windows & doors.

Storm windows and storm doors may be introduced as a means of helping to improve thermal efficiency within historic buildings. Table 3 demonstrates how some HPCs have incorporated standards regarding the installation of interior/exterior storm windows or doors into their guidelines.

Exterior storm windows can also be looked at as the traditional method of double-glazing which can achieve a U-value[10] for the window comparable to that found in insulating glass.[11] Essentially, adding a storm window unit creates a place for air to be warmed or cooled before entering the building. In addition to acting as insulated glass, exterior storm windows help reduce air infiltration, extend window longevity and reduce maintenance costs;[12] however, HPCs show preference to interior storm windows, as they have less of a visual impact on the architectural integrity of the building. Among the things that are important to consider when opting for interior storm windows over exterior storm windows is the likelihood of condensation build up between the window and the interior storm unit (this is primarily a concern for colder climates, but still needs to be taken into account). It is important that a window be in good repair prior to the installation of a storm unit. If not, the application of such a unit may cause further degradation of the window's historic fabric.

If interior storm windows are installed it is important to carefully monitor for condensation build up. This is to help prevent further deterioration of the window. Some steps that can be taken to prevent condensation include caulking and weather stripping. Another option would be to have "weep holes" installed in the storm unit; this creates an opening allowing trapped moisture to escape.

[10] U-Value: The U-value measures the rate of heat transfer through an object, so the lower the U-value, the lower the amount of heat loss.
[11] Fisher, C.E. (1986). Rehabilitating windows in historic buildings: an overview. In Fisher, C.E. (Ed.). The window handbook: successful strategies for rehabilitating windows in historic buildings. Washington, DC: National Park Service & Atlanta, GA: Georgia Institute of Technology.
[12] Fisher, C.E.

Table 3 Storm Windows & Doors

Guideline	Montford	Edenton	Beaufort	Wilmington	New Bern	Raleigh	Hillsborough	Wilson	Washington
Storm doors shall have full view glass with meeting rails or mullions that align with the meeting rails and mullions of the door.	X	X	X	X	X	X		X	X
When installing exterior or interior storm windows, use windows that are full length with a narrow profile that do not obscure or damage the existing sash and frame. Select exterior storm windows with a painted or baked enamel finish color that is compatible with the sash color. For double-hung windows, select operable storm windows with dividers that align with the existing sash. Interior storm windows are encouraged where appropriate.	X	X	X	X	X	X	X	X	X
When installing storm doors, use full light doors constructed of wood or aluminum with a baked enamel finish that do not obscure or damage the existing door and frame. Select storm doors with a painted, stained, or baked enamel finish color that is compatible with the color of the existing door.	X			X		X	X		X
If storm windows and doors are needed, they should be painted or have a baked enamel finish reflecting the color of the sash or existing door. Double hung windows should have operable storm window; meeting rails should align with the existing sash to prevent obscuring the window design.				X					
New storm windows, storm and screen doors should be tension mounted with airtight gaskets and weep holes to avoid build-up and condensation damage to historic windows.				X					
It is appropriate to preserve and maintain historic storm and screen doors.								X	

Note: See reference for specific source of guidelines as designated by municipality.

2.h. Windows & doors.

When historic buildings were constructed, builders were mindful of the natural elements (such as sunlight, wind, rain, etc.). This is especially apparent when analyzing the placement of windows on a historic home, further making them character defining features. Unlike modern buildings, windows on historic structures were installed on an as-needed basis, versus one driven by contemporary aesthetics. Historic windows were put in place to provide natural light and ventilation. While this element of the practicality of historic windows is what citizens often value in historic architecture, historic windows are often blamed as the primary source of energy loss in historic buildings. Because of this, historic property owners frequently consider the option of

replacement windows to increase thermal efficiency without carefully examining their current windows, which results in unnecessary costs.[13] When deliberating over replacement windows, property owners and HPCs alike need to bear in mind two important elements: sustainability or building green[14] and authenticity. Simple measures can be taken to preserve the historic integrity of the window, while simultaneously increasing thermal efficiency within the building. For example, if double hung[15] windows can be operated, this creates added energy benefits. Users are then able to open the window a few inches at both the top and the bottom. This allows for warmer air to escape from the top and cooler air to enter from the bottom, creating natural ventilation, heating and cooling.

When considering replacement windows, it is argued that single glazing is the culprit for energy loss, propelling historic property owners toward the idea of double-glazing, when in fact; air infiltration is mostly at fault for poor energy performance.[16] In addition to introducing storm window unites, reduction of air infiltration can easily be accomplished with simple, cost-effective ways such as caulking around the frames, making sure the glazing putty is sound, tightening loose-fitting sash, replacing cracked panes and adding high-quality weather-stripping.[17] Taking part in these standard measures to reduce air infiltration can contribute greatly to overall energy conservation within a historic building without having to replace historic windows. As can be noted in Table 4 and Table 5, most of the HPC windows/doors guidelines reviewed incorporate similar standards for rehabilitation into their specific guidelines.

Studies indicate that the replacement of historic wood windows with a marketed energy-efficient option is counterproductive in itself. By removing historic windows and replacing them, energy is lost in the procurement and manufacturing of the newer window model, while the original window is contributing to landfill waste. Additionally, a well maintained wood window can last well over 100 years, while replacement options have a life span of 10-20 years and will typically take the owner 30-40 years to recoup their energy-savings by opting for replacement windows.[18] Replacing historic windows with vinyl alternatives is neither a sustainable nor an energy efficient practice. In addition, once a wood window has been removed and replaced, it is very difficult to (if not impossible) to ever put back the historic window, or one of similar construction and authenticity.

[13] Fisher, C.E. (1986). Rehabilitating windows in historic buildings: an overview. In Fisher, C.E. (Ed.). The window handbook: successful strategies for rehabilitating windows in historic buildings. Washington, DC: National Park Service & Atlanta, GA: Georgia Institute of Technology.

[14] Sustainability and building green in regards to historic properties are considered to be a natural marriage. Building green emphasizes the use of renewable materials and waste reduction while sustainability considers the maintenance of materials to ensure that they withstand the test of time and are available for future generations.

[15] Double hung windows are those which can be opened from both the top and the bottom.

[16] Fisher, C.E.

[17] Fisher, C.E.

[18] "Old" wood window replacement window energy analysis: what those home improvement advertisements won't tell you!

Table 4 Windows & Doors

Guideline	Montford	Edenton	Beaufort	Wilmington	New Bern	Raleigh	Hillsborough	Wilson	Washington
Retain and preserve original windows and doors that contribute to the overall character and form of historic buildings, including functional and decorative features.	X	X	X	X	X	X	X	X	X
Replace in kind any portion or a window or door that is damaged or deteriorated beyond repair. If possible, match the original in design, dimension and material. Consider compatible substitute materials only if using the original material is not technically feasible.	X	X		X	X	X	X	X	
If replacement of a deteriorated window or door is necessary, replace the unit in kind, when possible, matching the design and the dimension of the original sash or panels, pane configuration, architectural trim, detailing and materials.	X	X	X	X		X		X	X
If a window or door is completely missing, replace it with a new unit based on available documentation of the original or a new design compatible with the original opening and the historic character of the building.	X	X				X	X	X	
Adding or changing original window and door openings shall not be permitted on the primary façade. If additional windows or door openings are desired, they should be installed on a rear or non-character defining façade of the building. Design such units to be compatible with the overall design of the building.	X	X	X	X	X	X	X	X	
New or replacement windows and doors on existing historic homes should be wood.	X		X	X	X				
It is appropriate to repair historic windows, doors and their details and features using accepted preservation methods rather than replacing them.		X	X	X	X	X	X	X	X
Replacement of historic windows and doors for the sole purpose of improved thermal performance is not appropriate. Wood, or appropriately painted metal storm windows and doors should be used.			X		X			X	
It is not appropriate to install entrance doors that create a false historic appearance.				X					
Follow a routine program of inspection and maintenance of windows and doors to avoid deterioration: Maintain a sound paint film on all wooden windows and doors. Check sills and thresholds to ensure that water runs off and does not collect. Maintain glazing putty around window glass to prevent air and water infiltration.				X					X
It is not appropriate to place skylights in roof locations that are visible from the public right-of-way.					X				

Guideline (continued from previous page)	Montford	Edenton	Beaufort	Wilmington	New Bern	Raleigh	Hillsborough	Wilson	Washington
It is not appropriate to create a false sense of historical development by making changes to windows or doors, such as adding conjectural features based upon insufficient historical, pictorial, or physical documentation.							X		
It is not appropriate to remove original doors, windows, shutters, blinds, hardware and trim from a character-defining facade.					X	X			
Maintain the visual emphasis of windows and doors (vertical/horizontal orientation).								X	
It is appropriate to use steel doors for security on rear entrances provided they are painted to match other doors on the house.								X	
It is inappropriate to use steel doors and those with windows incompatible with the style of the structure and other elements.								X	
Sliding glass doors shall be inconspicuously located at the rear elevation of the building.								X	
It is only appropriate to install new attic dormers, windows, or doors as required for adaptive reuse in secondary or tertiary areas of visual concern.								X	

Note: See reference for specific source of guidelines as designated by municipality.

Table 5 Windows Only

Guideline	Montford	Edenton	Beaufort	Wilmington	New Bern	Raleigh	Hillsborough	Wilson	Washington
It is not appropriate to use snap-in muntins to create a false divided light appearance.	X	X	X	X	X	X		X	X
It is inappropriate to remove original window materials including glass, stained glass, textured glass, leaded glass, beveled glass, glass block and tracery unless an accurate restoration necessitates its removal.		X				X	X		
The replacement of clear glass or historic stained glass with tinted, textured, or opaque glass is not appropriate.		X		X					X
Tinted glass is not appropriate in the historic district in any area visible from public view. Energy-saving or "low-E" glass may be used only if it is not tinted.			X						
Tinted glazing is not appropriate as replacement glazing in historic windows.					X	X		X	
It is not appropriate to replace multi-light sash with new thermal sash; use storm windows to preserve original material.				X			X		
It is not appropriate to replace operable windows and transoms with fixed glazing, to replace clear glazing with tinted glazing, or to replace multiple paned doors or windows with single thermal sash with flat, applied muntins.							X		

Note: See reference for specific source of guidelines as designated by municipality.

2.i. Insulation.

As previously noted, historic windows are often blamed as the culprit for energy loss in a historic building. Air infiltration is the most likely explanation. Air infiltration may be greatly reduced with the introduction of insulation. However, in reference to historic structures, insulation can be a very touchy subject. Even though insulation is not visible from a building's exterior, it is still an issue to be addressed by HPCs. What many property owners do not realize is that insulation loses its effect over time, providing little to no insulating quality whatsoever. For example, most people will recognize the pink fluffy fiberglass insulation that can be found in home improvement stores. Overtime, this insulation becomes compressed and does not serve its original purpose. This is why it may be necessary to replace insulation periodically. There are a variety of installation practices as well as types of insulation available.

Thermal insulation is defined by its R-value, or resistance to heat flow. The higher the R-value, the greater the insulating quality will be. In other words, there is potential that air

infiltration will be reduced if insulation is installed or replaced. Some issues with installation should be recognized. If properly installed, insulation can prevent air infiltration; however, if it is not installed properly, insulation can create an environment that welcomes moisture entrapment that can lead to further deterioration of the structure. Older buildings were built to breathe and ventilate naturally. When originally constructed, historic buildings did not contain insulation and may have had been treated with preservatives that prevent the future installation of insulation. Improper use of insulation may prevent moisture from escaping the way it was originally intended. The use of a moisture barrier and skilled installation may resolve these issues. Studies indicate that insulation installed in attics, basements and crawl spaces will provide better thermal performance without much damage to the buildings character.

3. Energy Retrofit for Mechanical Systems and Alternative Energy Sources

As times progress and energy resources become scarcer, an increased demand for alternative energy sources has come about. Simultaneously, cost is the principle obstacle in the adoption of renewable technologies; generating electricity from fossil fuels is far cheaper (from an economic standpoint) than from renewable energy technologies.[19] When considering the use of alternative energy systems, one first needs to consider the benefit of installing the system and if the renewable elements utilized will be predictable (i.e. the sun does not always shine, the wind does not always blow, etc.)[20] One must also consider the visual impact that the installation of these non-traditional systems may have on the historic property and if these impacts are in compliance with the *Standards* or the local HPC guidelines. The production of some form of tax credit may be used to incentivize property owners to invest in some of these green renewable technologies.[21]

3.a. Mechanical systems.

Even though mechanical systems and equipment are not traditional historic architectural features, they do exist and should not be ignored. Table 6 illustrates how some of the local HPCs in North Carolina have set guidelines regarding new and existing mechanical equipment in its district. In the realm of energy efficiency, none of these specific guidelines mention how to get the best and most efficient use of current mechanical systems. This problem may be offset by the installation of thermal insulation in attics and basements ensuring minimal energy loss and maximum performance.

[19] National Academy of Sciences, National Academy of Engineering, & National Research Council. (2010). Electricity from renewable resources: status, prospects and impediments. Washington, DC: The National Academy Press.
[20] Lynn, P.A. (2010). Electricity from sunlight: an introduction to photovoltaics. West Sussex, United Kingdom: John Wiley & Sons Ltd.
[21] National Academy of Sciences, National Academy of Engineering, & National Research Council

Table 6 Mechanical Systems

Guideline	Montford	Wilmington	Raleigh	Hillsborough	Wilson	Washington
When installing a new mechanical system, install it so that it causes the least amount of alteration to the building's exterior elevations, historic building fabric and site features.	X	X	X		X	X
Locate new mechanical equipment and utilities, such as heating and air-conditioning units, meters and fuel tanks, in inconspicuous locations. Where possible screen with plantings or fence.		X	X	X	X	X
Encourage the use of underground utility lines if upgrading the power supply is being considered. Care should be taken not to disturb large tree roots and archaeological resources.		X	X	X	X	
Locate window air-conditioning units on rear or side elevations.		X	X		X	X
It is not appropriate to install solar collectors or mechanical equipment on roof slopes that are visible from the public right of way. Antennas and satellite dishes are to be located in an inconspicuous manner, taking into consideration the received signal strength and the nature of the installation.		X	X	X	X	X
Install low-profile ridge vents only if they will not destroy historic roofing materials and details.				X		
It is not appropriate to introduce contemporary communication equipment that is inconsistent with the historic character of the districts, including large-scale antennas and satellite dishes, in locations visible from the street.			X		X	X
It is appropriate to use existing openings for utility connections whenever possible. Locate utility connections and vents through walls, roofs, or foundations on secondary or tertiary areas of visual concern where they are not visible from public view.					X	
Where allowed by the utility company, paint meter boxes, vents and other utility connections in colors that will blend with the historic building and screen them from view.					X	
It is inappropriate to puncture a standing seam metal, slate, asbestos, or tile roof for any utility application including the installation of satellite dishes or antennae.					X	

Note: See reference for specific source of guidelines as designated by municipality.

3.b. Photovoltaics (solar collectors).

Photovoltaics (PV), commonly known as solar collectors, are a carbon-free technology that converts sunlight directly into electricity.[22] Since its development, PV systems are divided into two broad categories; grid-connected systems[23] and stand-alone systems[24].[25] The cost-effectiveness of PV systems crucially depends on positioning and ability to collect as much sunlight as possible. In the Northern Hemisphere, it is recommended that PV systems be facing South directed at the midday Sun (the location of the Sun at noon). Any deviation from South, such as may be the case when considering placement on properties with existing and/or historic buildings and should not exceed 30˚. Second, PV systems should be tilted down from the horizon so that Sun's rays at solar noon are normal to its surface (should form a 90˚ angle with the Sun's rays at solar noon).[26] Such placement of PV systems is to ensure maximum sun collection.

In addition to the parameters set forth in order for PV collectors to be a viable renewable energy resource on existing and historic buildings, one must also evaluate the visual impact that these systems will have on the property. Being a non-traditional element of historic architecture, it is natural that HPCs may restrict installation of these features on certain locations of historic properties. For example, in order for PVs to be a cost-effective energy option for owners, they should want to install the system on a portion of the structure facing south, thus maximizing sun collection. If the primary façade of the building is facing south or visible from the public right of way, it is unlikely that the installation of a PV system will be allowed. Before any decisions on installing PV systems in a historic district, it would be important to review any local ordinances or HPC guidelines.

3.c. Wind systems.

Wind is an abundant and renewable energy resource. Wind technologies use wind turbines and related components to capture the wind's kinetic energy[27] and transforms it into usable electricity.[28] Because wind speeds are greater in higher elevations, most wind systems stand at a height close to 300 feet.[29] Due to the construction of wind capturing technologies, many people deem them to be an eyesore. This can be especially true regarding historic properties. Wind turbines are not traditional elements of a historic property and HPC guidelines have been tailored so as to limit the visual effects of them when placed on historic properties. Standards suggest that wind systems should be located so as to minimize the visual impact it may have on the property and should not be visible from public right of ways.

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[22] Lynn, P.A. (2010). Electricity from sunlight: an introduction to photovoltaics. West Sussex, United Kingdom: John Wiley & Sons Ltd.

[23] Grid Connected Systems: (also called *grid-tied systems*) feed any surplus PV electricity into a grid and accept electricity from the grid when there is a solar deficit (Lynn, 2010)

[24] Stand-Alone Systems: are self-contained and not tied to a conventional electricity grid (Lynn, 2010)

[25] Lynn, P.A.

[26] Lynn, P.A.

[27] Kinetic energy is energy that is in motion, or active energy.

[28] National Academy of Sciences, National Academy of Engineering, & National Research Council. (2010) Electricity from renewable resources: status, prospects and impediments. Washington, DC: The National Academy Press.

[29] National Academy of Sciences, National Academy of Engineering, & National Research Council.

Because so few of these emerging technologies (solar and wind) are seen in residential construction or historic preservation districts, very few HPCs have incorporated standards in its guidelines for regulation in historic districts. Of the local HPC guidelines in North Carolina analyzed, only one HPC created a section detailing what is and what is not an appropriate use of these technologies on a historic property. Montford, North Carolina has incorporated specific regulations into its HPC guidelines. Figure 3 details the explicit guidelines it has set forth.

Figure 3: Emerging Technology Retrofit

1. Solar energy collectors shall be located as inconspicuously as possible while still allowing for reasonable use. Every effort should be made to limit impact of historic character defining features.
2. Installation of solar devices on roof surfaces facing the primary public right-of-way shall be considered only when no other option is possible and there is no detrimental impact to the integrity of historic structure and neighborhood. All work must be easily reversible.
3. Solar energy collectors shall not be located in the front yard.
4. Every effort shall be made to screen solar energy collectors from the public view, provided this restriction does not have the effect of preventing the reasonable use of a solar-energy collector.
5. Solar collectors must be mounted as flush as possible with the roof and not extend beyond any roof ridge.
6. Trees or existing historic structures should not be removed to provide adequate solar exposure but should be taken into account when siting collector location and orientation to allow for reasonable efficiency.
7. Solar shingles shall be located as inconspicuously as possible and blend in with the color of the roof surface.
8. Thin-film photovoltaic material on standing seam metal roofs should be located as inconspicuously possible and shall blend with the roof surface and color.
9. Wind turbines shall be located as inconspicuously as possible and shall not be located in the front yard.
10. The color or the external portions of any installed wind collector must be unobtrusive and blend with the surrounding environment.

Note: These are specific guidelines found in Montford's Historic Preservation Guidelines

4. Financing for Energy and Preservation Retrofit

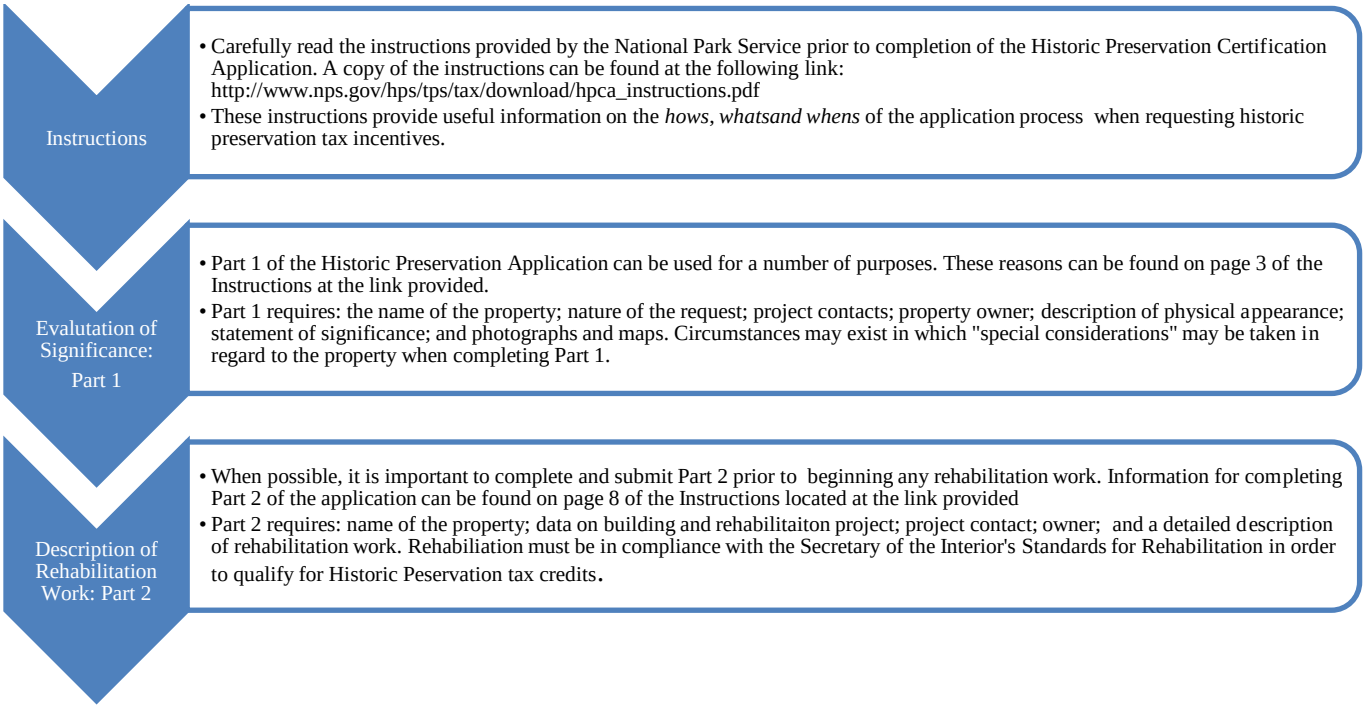
The ability to afford to energy retrofit may prove to be an obstacle for some homeowners. This need not be the case. The Federal government provides several opportunities through Historic Preservation Tax Incentives and the Department of Housing and Urban Development (HUD) to help offset some of these costs. Additionally, the State of North Carolina also offers some preservation tax incentives for historic buildings. By coupling the use of a mortgage

program and/or tax incentive(s), the retrofit of a historic building is a feasible idea allowing for both the preservation and energy retrofit of a home.

4.a. Federal tax incentives: Historic Preservation Tax Incentives Program.

Figure 4 provides an explanation of the National Historic Preservation Certification Application in a systematic process. In order to qualify for Federal preservation tax credits, the building must first receive a Certification of Historic Significance[30] (Part 1s). If a building qualifies as one with significance, it may be eligible to receive a 20% tax credit of the amount spent. Those buildings, which are not deemed as significant, may qualify for a 10% Federal tax credit if it is rehabilitated for income-producing, non-residential purposes. Owners seeking certification of rehabilitation work must complete Part 2 on the Historic Preservation Certification Application.[31] Certifications of completed projects (Part 3s) are issued when all rehabilitation work is completed on a certified historic building, thus allowing for eligibility of the tax credit. Rehabilitation not in compliance with the Secretary of the Interior's Standards for Rehabilitation may void the possibility of any Federal tax credit. The use of historic preservation Federal tax credits usually does not preclude the use of other Federal, state, or local funding sources.[32]

Figure 4: National Historic Preservation Certification Application Process



[30] Certifications of Historic Significance (Part 1s) are issued by the National Park Service (NPS). In order to qualify, a building must be listed individually on the National Register of Historic Places, or be certified as contributing to a certified historic district. The NPS also certifies buildings that considered non-significant and do not contribute to a certified historic districts. In order for these to qualify, the building must pre-date 1936.

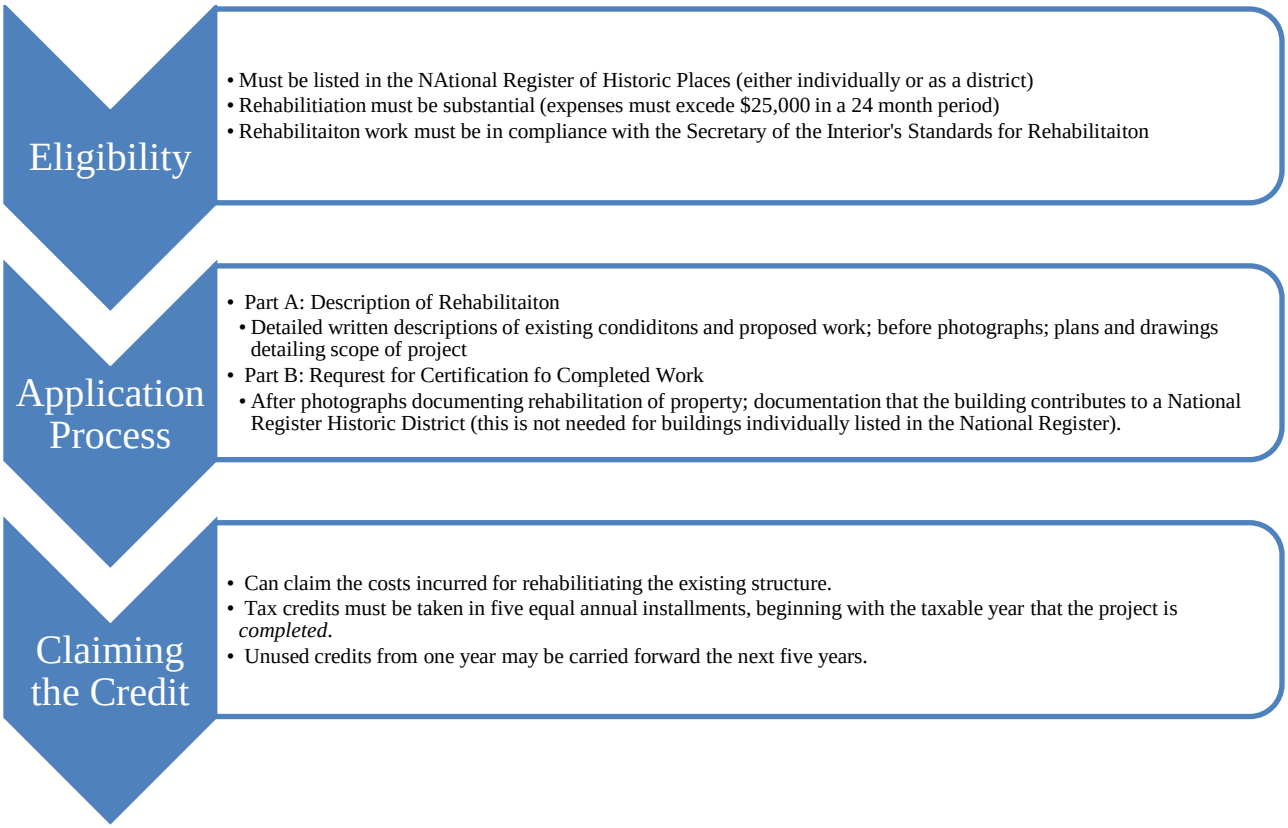
[31] National Park Service United States Department of the Interior. (2009). *Historic preservation tax incentives*. Washington, DC: Technical Preservation Services.

[32] National Park Service United States Department of the Interior. (2010). *Federal tax incentives for rehabilitating historic buildings*. Washington, DC: Technical Preservation Services.

4.b. State tax incentives.

The North Carolina State Historic Preservation Office offers a 30% state tax credit[33] offered to owners of historic buildings for qualified rehabilitations of non-income-producing structures. In order to be eligible for this tax credit, buildings must be listed individually in the National Register of Historic Places or as a contributing building in a National Register historic district. The rehabilitation of the historic structure must be substantial.[34] Additionally, all rehabilitation work must be in compliance with the *Standards*. The tax credit application is a two-step process. Part A includes a detailed description of existing conditions and the proposed work, prior to beginning a rehabilitation project. Part B consists of after photos documenting the completed project. Claiming credits are limited to the rehabilitation of the existing structure (excludes additions, cost of acquisition, site work, or personal property). The tax credits must be claimed in five equal annual installments, beginning with the taxable year the project is completed.[35] Figure 5 provides explanation of the application process to receive North Carolina tax credits.

Figure 5: North Carolina Residential/Homeowner Historic Preservation Tax Credit Process



[33] National Park Service United States Department of the Interior. Historic Preservation Certification Application: Instructions. Washington, DC. Retrieved from http://www.hpo.ncdcr.gov/TaxCredits/Homeowner%20Fact%20SheetWeb.pdf

[34] In this case, substantial rehabilitation refers to expenses exceeding $25,000 in a 24 month period. This does not exclude a project taking longer than 24 months.

[35] North Carolina State Historic Preservation Office. *Residential/homeowner historic preservation tax credits*. Department of Cultural Resources and the Office of Archives and History.

4.c. Energy efficient mortgages.

The Federal Housing Administration (FHA) offers the Energy Efficient Mortgage (EEM) Program to help offset utility costs in a home. The EEM can be used to finance the purchase of a home – or refinance the current mortgage – to include the cost of the energy-saving, cost-efficient improvements through a single mortgage. The cost of energy-efficient improvements determined to be cost effective[36] may be financed into the mortgage.[37] The maximum cost of improvement that may be added to the mortgage is either 5 percent of the property's value (not to exceed $8,000) or $4,000, whichever is greater based on the value of the property.[38] EEMs may be applied for with any participating and approved lender. Contact the regional HUD office or visit www.hud.gov for a list of approved lenders.

4.d. 203(k) mortgages.

The FHA also administers a variety of single-family mortgage insurance programs, including its 203(k) program. The 203(k) program acts as a rehabilitation loan allowing for the borrower to obtain monies equal to the initial acquisition of the property as well as rehabilitate it. Eligible improvements that the program may finance include items such as painting, room additions, decks and other items; however, all health, safety and energy conservation items must be addressed prior to completing general home improvements.[39] Contact HUD or visit www.hud.gov for a list of approved lenders.

[36] Cost effective means that the total cost of the improvements, including any maintenance costs, is less that the total present value of the energy saved over the useful life of the energy improvement.
[37] Federal Housing Administration. FHA's Energy Efficient Mortgage (EEM) Fact Sheet. Retrieved from: http://www.energystar.gov/ia/partners/bldrs_lenders_raters/EEM_Fact_Sheet.pdf
[38] Federal Housing Administration
[39] Department of Housing and Urban Development. Rehab a home with HUDs 203(k). Retrieved from: http://www.hud.gov/offices/hsg/sfh/203k/203kabou.cfm

5. Recommendations and Alternatives

Before construction of specific guidelines for energy efficiency are developed, the local HPC should compose a comprehensive strategy detailing overarching goals and objectives of energy efficiency and energy retrofit guidelines.[40] This is done to prevent the adoption of single-issue policies that focus primarily on a topic such as windows or solar collectors. It is important to provide an overview of how individual guidelines fit into a more comprehensive strategy.[41] This can be accomplished by first defining clear goals for sustainability in relation to the current historic resources, followed by an outline of how specific topics will be organized and concluded by determining the format in which the finished materials will be published.[42]

"A set of general sustainability concepts should appear as a background to the design guidelines."[43] In this, the local HPC should identify broad concepts that will reinforce more specific criteria and guidelines that will follow. General categories that may be considered include resource conservation[44], energy conservation[45] and energy generation[46].[47]

Resource conservation strategies focus on the re-use of materials as opposed to new construction and/or the replacement of original building materials for those marketed as energy-efficient. In 2008, the Empty Homes Agency (located in the United Kingdom) published results from a study indicating that it takes between 35 and 50 years for a new, energy efficient home to recover from the carbon expended during the construction process.[48] Encouraging the use and maintenance of current building materials will limit the need for replacement features that may not have the same life-cycle expectancy[49] as the older materials already present. A life-cycle analysis[50] may be emphasized or required of property owners when considering the use of replacement materials on a building. A life-cycle analysis will also support the reasoning to retain traditional and historic features.[51] Energy conservation goals relate to the utilization of inherent energy saving features found on many historic buildings. Energy generation suggests that the property owner develop a personal energy strategy prior to making any major alterations

[40] Winter, N.V. (2011). *Developing sustainability guidelines for historic districts*. National Trust for Historic Preservation. Washington, DC.
[41] Winter, N.V.
[42] Winter, N.V.
[43] Winter, N.V. page 4
[44] Resource conservation focuses on making the best use of existing buildings and land.
[45] Energy conservation focuses on the reduction of energy consumption for a property and ultimately becomes the main objective for property owners.
[46] Energy generation focuses on a reduction in the demand for public utilities and minimization of operational costs. Examples of energy generation methods include the installation and use of solar collectors and/or wind turbines.
[47] Winter, N.V..
[48] Empty Homes Agency. (2008). *New tricks for old bricks*. Building and Social Housing Foundation. London, England.
[49] Life-cycle expectancy refers to the length of time a material or product is expected to last. For example, replacement vinyl windows have an average life-cycle expectancy of around 20 years whereas original wooden windows (if properly maintained) can last a century or more.
[50] A life-cycle analysis compares the "costs" of materials to the longevity of the material. Often, more traditional materials will score the highest because they have less pollution associated with manufacturing and will last longer. (Winter, N.V.)
[51] Winter, N.V.

to an existing structure. The energy strategy should be composed of an energy audit[52], the setting of goals for sustainability as a part of the project[53], the identification of management strategies to improve energy efficiency[54] and the development of components for the strategy[55].[56]

After setting clear goals for the development of sustainability guidelines, a local HPC should outline how it wants to organize the guidelines. This may follow the traditional outline and structure found within the HPC's local preservation guidelines. One example might include the creation of a rehabilitation section focusing on the use of appropriate (or inappropriate) energy conservation and energy generation techniques.[57] Another example might be incorporated into a section on additions to historic structures, new construction, or landscape design. Some examples on how to structure specific guidelines for local design guidelines can be found in the National Trust for Historic Preservation's booklet on *Developing Sustainability Guidelines for Historic Districts*. This booklet provides specific guidance on topics such as awnings, windows, building insulation and emerging technologies. The City of Washington's *Historic Preservation Guidelines* already contain some sound policies; however, these may need to be reinforced with language that is more specific and concrete. This language might also have more effect if accompanied by narratives that explain and reinforce current guidelines. In regard to emerging technology and more specifically, photovoltaics (solar collectors), the local HPC should be aware of any solar access of solar rights[58] legislation.[59] North Carolina has several general statutes pertaining to solar access. The statutes will be provided and explained in the Appendix.

The third and final step in the production of specific guidelines for energy efficiency and retrofit in historic preservation is deciding how to develop the new guidelines. This can be done in a number of ways. The first option would be to interlace specific guidelines for energy efficiency throughout the current guidelines in place. This would reinforce the current guidelines in place and provide explanation as to how some of the current practices are inherently "green" but were not specifically identified as such. The downside to this approach is the risk that the current guidelines may need to be completely re-written and/or re-structured; this can be a very daunting and time-consuming task. A second option would be the creation of a separate chapter that contains specific guidelines for sustainability, energy efficiency and retrofit. This helps focus attention on "green building" issues and make it easier to quickly convey to the public that the issue has been addressed, however, when this approach is taken, these chapters tend to focus

[52] An energy audit can be conducted to assist with the understanding of how energy is used in an building and identify ways in which energy performance might be improved.
[53] These are broad objectives that are made to help identify individual actions that may be conducted to help improve energy conservation in a building. For example, increasing insulation to help reduce air infiltration should take priority over window replacement.
[54] These management strategies usually identify certain operational measures that may be taken to help improve energy conservation in a building. These management strategies may also be introduced into a section with specific guidelines by the local HPC.
[55] This is the final part of the energy strategy. It simply allows for the property owner to present the findings as evidence and support to the local HPC when submitting a specific request for making alterations to the existing structure.
[56] Winter, N.V. (2011). Developing sustainability guidelines for historic districts. National Trust for Historic Preservation. Washington, DC
[57] Winter, N.V.
[58] Solar rights refers to the ability to install solar energy systems on residential and commercial property that is subject to private restrictions.
[59] Winter, N.V.

primarily on emerging technologies and disregard other factors such as inherent energy saving features.[60]

5.a. Passive measures.

The passive measures detailed in previous sections are the best ways to improve energy efficiency in historic structures without damaging the historic integrity of the building. The use of these measures should be encouraged as opposed to energy retrofitting. The following paragraphs provide more detailed explanations of how historic property owners may be encouraged to utilize passive measures in their homes. To reiterate a previous point, utilization of features already present in a building is an inherently green and sustainable practice. By doing so, the embodied energy that has already been procured in the construction and maintenance of a building has not gone to waste. Furthermore, replacement of features will not contribute to the stuffing of landfills. Additionally, the historic integrity of the building will be preserved for future generations.

5.a.i. Operational controls.

The operational controls found in Figure 2 are great, non-invasive ways to improve energy use in historic structures. Examples include lowering the thermostat in the winter (68° F) and raising it in the summer (78° F); controlling the temperature in rooms actually used by means of closing/opening vents and using programmable thermostats; maximizing natural light; maximizing fresh air and natural ventilation; and having mechanical equipment serviced regularly. It is recommended that the HPC encourage historic property owners to take part in utilization of these operational measures. For example, the City of Washington currently recommends to all residents that they lower their thermostats in the winter and raise it during the summer. Keeping the thermostat set at 78º F is recommended for warmer months and for each degree set below 78º F adds about three percent to energy bills.[61] During cooler times of the year, it is recommended that thermostats be set between 68-72ºF. By encouraging the use of the operational controls mentioned in this document, property owners may reduce their energy costs without significant impact to the structure.

5.a.ii. Shade trees.

Trees provide an aesthetic value to a property, and they also deliver practical benefits. Though newly planted trees may not provide immediate energy saving benefits, in time they may help reduce the need to use electrical systems throughout the year. The HPC should continue in its practice of monitoring the planting and cutting down of trees in the historic district. The HPC may also consider consulting with the local garden club in helping to identify which trees and shrubs are most appropriate for the historic time period of the district and/or property.

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[60] Winter, N.V. (2011). Developing sustainability guidelines for historic districts. National Trust for Historic Preservation. Washington, DC.

[61] NC Public Power. *Stay cool this summer without heating up your power bill*. Retrieved from: http://www.ci.washington.nc.us/client_resources/energy%20tips/stay_cool_this_summer%20sflb.pdf

5.a.iii. Awnings & overhanging eaves.

As can be noted previously in this document, awnings and overhanging eaves have practical value when used in conjunction with historic structures. The City of Washington's HPC Guidelines currently have standards in place to monitor the use of awnings in the historic district. It is recommended that the HPC continue with the current policies in place as they are in keeping with both the Secretary of the Interiors *Standards* and in liking with other HPC Guidelines throughout the state. The HPC may consider encouraging the use of awnings on buildings where historically appropriate in lieu of major energy retrofit.

5.a.iv. Paint color.

The HPC should continue in its current regulation of paint in the historic district. Paint color should not be restricted, however, lighter hews should be encouraged to property owners undergoing new paint jobs to the exterior of their buildings. Some examples that may be recommended are lighter shades of blues, purples, yellows, or pinks; preferably on a pastel color scale. Paint color should also be in keeping with the period of the district.

5.a.v. Porches.

The HPC should continue in its current regulation of porches and any potential alteration and/or maintenance. Porches are integral architectural features on a historic property and proper maintenance and care should be stressed. Not only do porches provide an architectural aesthetic, they also serve as the social focus of a historic building, as they provide a cool place to meet with neighbors to escape hot suns.

5.a.vi. Shutters.

The City of Washington's HPC Guidelines regulating the use and placement of shutters in the historic district are much different than those found in other historic districts throughout the state. Following careful review of the Washington Guidelines, only two regulations have been enacted to this effect. One is quite similar to the others across the state in that it recommends the replacement of shutters where historically appropriate. Variation is found when looking at the operability factor of shutters. The current HPC Guidelines suggest that shutters should have the appearance of being functional, whereas other districts require that they be operable. It is recommended that the City of Washington's HPC Guidelines rephrase its current guidelines to require that shutters be operable. Shutters should be sized to fit the window opening and should be attached to hinges, as is appropriate. Shutters should not be affixed to the building, as this could cause damage to the building's wood features. Though this may seem to be irrelevant, research indicates that shutters are not only integral aesthetic architectural features, but also provide energy saving benefits in historic buildings. Additional recommendations include that the HPC continue to regulate wood versus vinyl shutters in the district.

5.a.vii. Storm windows & doors.

As can be noted by Table 3, the City of Washington's HPC Guidelines currently have some regulation of storm windows and doors located within the historic district. It is advised that the HPC consider adding additional standards to help regulate the use and/or installation of storm windows and doors in the historic district. Some examples that may be cited are located within

the guidelines of the Wilmington and Wilson historic districts. More specifically, Wilmington requires that storm windows and doors be mounted in a certain way and with weep holes, to prevent condensation buildup. Wilmington also requires that storm units used with double-hung windows be operable in fashion. Wilson encourages the preservation and maintenance of historic storm units. It is recommended that the HPC encourage the use of storm windows as an alternative to replacement windows or other major retrofit options. As is previously mentioned, storm windows provide the effect of insulated or thermal glass and can greatly improve energy use within the building. Some HPCs suggest the use of interior storm windows as opposed to exterior storm windows. However, they do not explicitly restrict property owners to the use of interior storm windows. It may or may not be recommended by the HPC to use interior storm windows as a preferred alternative.

5.a.viii. Windows & doors.

It is recommended that the City of Washington's HPC revisit its guidelines for windows and doors. As can be noted by Tables 4 and 5, the HPC offers limited guidance in its windows and doors sections in contrast to other HPCs throughout the state. The HPC Guidelines for Beaufort and New Bern both have fairly comprehensive sections for the regulation of windows and doors. For example, the guidelines for Beaufort and New Bern require that new or replacement windows and doors on homes be made of wood. Also noted is that these guidelines prohibit the replacement of windows and doors for the sole purpose of thermal improvement. In contrast, these guidelines encourage the use and installation of storm window units to improve thermal efficiency. The guidelines for these districts also regulate the use of tinted glass in areas visible from the public right-of-way. Beaufort guidelines do allow for the use of energy-saving or "low-E" glass, but only if it is not tinted. Similarly, these guidelines highlight that the use of tinted glazing is not appropriate as replacement glazing in historic windows. It is recommended that the HPC consider modeling new standards after the guidelines mentioned in the described sections. The HPC should also regulate the use of alternative materials when considered with window replacement. As can be noted by the standards in place for other historic districts across the state, vinyl or other alternative window material is frowned upon. Allowing such replacement to occur would not be in keeping with the *Standards*, would detract from the historic value of the building and may create an opportunity for the historic district to lose in recognition as a National Register district.

5.a.ix. Insulation.

As noted previously in this document, insulation remains to be a very touchy subject in the realm of improving energy use in historic buildings. It is recommended that requests coming to the HPC by property owners be looked at carefully on a case-by-case basis. It may be difficult for the HPC to formulate specific guidelines regulating the installation and use of insulation in historic buildings; however, due to the potential that there may be structural alterations made, some regulation of installation. Some of the guidelines looked at across the state included some variation that showed preference to insulation that is installed by being "blown in" to the siding of structure, such as is the case with Beaufort's Guidelines. The historic district guidelines of Montford & Raleigh encourage the installation of insulation in attics, crawl spaces, around duct work and in basements as these are areas of major energy and heat loss. It is recommended that the City of Washington's HPC create similar guidelines to encourage these practices if feasible for the property owner. If insulation is not feasible for a property, it is recommended that the

HPC encourage the use of caulking and/or weather-stripping around door and window frames, as well as any other cracks where air infiltration may be an issue.

5.b. Energy retrofit for mechanical systems and alternative energy sources.

The passive measures described in the previous sections are the best ways for historic property owners to improve energy use in their homes. In addition to being the most cost-efficient alternatives for the property owner, these measures and improvements create only minimal change to the building's structure and architectural features. Though this may be the case, it is still important to develop guidelines for property owners who may choose to take an alternative path to saving energy in their home. Some such examples may include those who wish to install mechanical systems or emerging energy technologies, such as solar or wind collectors. The following sections provide information on how the HPC may incorporate new regulations into its current guidelines to include sections for mechanical systems and emerging technology energy retrofit.

5.b.i. Mechanical systems.

As can be noted by the information provided in Table 6, the City of Washington's HPC Guidelines for mechanical systems provided many similarities to the guidelines of the Montford, Wilmington, Raleigh, Hillsborough and Wilson historic districts. It is recommended that the HPC continue in its current regulation of mechanical and communication systems guidelines. The HPC may also include language that would recommend that the property owner have mechanical systems serviced on a regular basis to ensure that these systems are working as efficiently as possible. Though it has not been observed in the guidelines researched, the HPC may also consider encouraging the purchase of mechanical systems that have a higher S.E.E.R. rating[62] to further decrease energy consumption.

5.b.ii. Solar & wind.

Though the use of wind to capture energy is a concept that has been around for centuries and in liking, solar powered energy generation has been around for nearly half of a century, HPCs tend to dance around these concepts in regard to regulating them in their guidelines. Of the nine HPC guidelines analyzed in this document, only one historic district in North Carolina has enacted specific policy in its guidelines to the effect of regulating emerging technologies. It is recommended that the City of Washington's HPC borrow language found in the *Montford Historic District Design Review Guidelines* as it moves forward in creating a new section to accommodate solar and wind energy retrofits. For example, these guidelines do not prohibit the installation of solar or wind collectors on a historic property. Rather, these guidelines regulate the visual impact that the technology may have on a property once introduced. The guidelines encourage that every effort be taken not to interfere with the historic aesthetic of the building. It is recommended that the City of Washington's HPC evaluate the use of alternative energy technologies on a case-by-case basis as it comes before the Commission.

[62] S.E.E.R. (Seasonal Energy Efficiency Ratio) ratings: ratings go up to 26 and he higher the rating the more energy efficient the product. At current, it is required that all residential air conditioning units sold have a minimum SEER of 14. Units are available with higher ratings than this.

Because the City of Washington's current set of codes and ordinances contains no regulation of the use of solar and wind powered energy, the City may need to develop some such ordinance so as to be in compliance with North Carolina General Statutes. Such an ordinance may delegate authority and jurisdiction to the City of Washington's HPC so that they may regulate the use of solar and wind collectors within the historic district.

6. Conclusion

As evidenced by this research and comparison of the guidelines enacted by several communities throughout North Carolina, expensive and substantial alterations of are not necessary to improve energy efficiency in historic properties. Simple, non-evasive steps taken through proper maintenance and repair can result in considerable energy savings. Similarly, if need be, more active, introduction of renewable energy technologies may be introduced without causing significant damage to the property. As discussed, a variety of measures may be taken by residents which will permit them to maintain the historic character of their property, while also improving their energy efficiency or reducing their rates of energy usage.

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8. **Appendix: North Carolina Solar Legislation**

§ 160A 400.4. Designation of historic districts.

(a) Any municipal governing board may, as part of a zoning or other ordinance enacted or amended pursuant to this Article, designate and from time to time amend one or more historic districts within the area subject to the ordinance. Such ordinance may treat historic districts either as a separate use district classification or as districts which overlay other zoning districts. Where historic districts are designated as separate use districts, the zoning ordinance may include as uses by right or as conditional uses those uses found by the Preservation Commission to have existed during the period sought to be restored or preserved, or to be compatible with the restoration or preservation of the district.

(b) No historic district or districts shall be designated under subsection (a) of this section until:

(1) An investigation and report describing the significance of the buildings, structures, features, sites or surroundings included in any such proposed district and a description of the boundaries of such district has been prepared and

(2) The Department of Cultural Resources, acting through the State Historic Preservation Officer or his or her designee, shall have made an analysis of and recommendations concerning such report and description of proposed boundaries. Failure of the department to submit its written analysis and recommendations to the municipal governing board within 30 calendar days after a written request for such analysis has been received by the Department of Cultural Resources shall relieve the municipality of any responsibility for awaiting such analysis and said board may at any time thereafter take any necessary action to adopt or amend its zoning ordinance.

(c) The municipal governing board may also, in its discretion, refer the report and proposed boundaries under subsection (b) of this section to any local preservation commission or other interested body for its recommendations prior to taking action to amend the zoning ordinance. With respect to any changes in the boundaries of such district subsequent to its initial establishment, or the creation of additional districts within the jurisdiction, the investigative studies and reports required by subdivision (1) of subsection (b) of this section shall be prepared by the preservation commission and shall be referred to the local planning agency for its review and comment according to procedures set forth in the zoning ordinance. Changes in the boundaries of an initial district or proposal for additional districts shall also be submitted to the Department of Cultural Resources in accordance with the provisions of subdivision (2) of subsection (b) of this section.

On receipt of these reports and recommendations, the municipality may proceed in the same manner as would otherwise be required for the adoption or amendment of any appropriate zoning ordinance provisions.

(d) The provisions of G.S. 160A 201 apply to zoning or other ordinances pertaining to historic districts and the authority under G.S. 160A 201(b) for the ordinance to regulate the location or screening of solar collectors may encompass requiring the use of plantings or other measures to ensure that the use of solar collectors is not incongruous with the special character of the district. (1989, c. 706, s. 2; 2009 553, s. 4.)

§ 160A 201. Limitations on regulating solar collectors.

(a) Except as provided in subsection (c) of this section, no city ordinance shall prohibit, or have the effect of prohibiting, the installation of a solar collector that gathers solar radiation as a substitute for traditional energy for water heating, active space heating and cooling, passive heating, or generating electricity for a residential property and no person shall be denied permission by a city to install a solar collector that gathers solar radiation as a substitute for traditional energy for water heating, active space heating and cooling, passive heating, or generating electricity for a residential property. As used in this section, the term "residential property" means property where the predominant use is for residential purposes.
(b) This section does not prohibit an ordinance regulating the location or screening of solar collectors as described in subsection (a) of this section, provided the ordinance does not have the effect of preventing the reasonable use of a solar collector for a residential property.
(c) This section does not prohibit an ordinance that would prohibit the location of solar collectors as described in subsection (a) of this section that are visible by a person on the ground:
(1) On the facade of a structure that faces areas open to common or public access;
(2) On a roof surface that slopes downward toward the same areas open to common or public access that the facade of the structure faces; or
(3) Within the area set off by a line running across the facade of the structure extending to the property boundaries on either side of the façade and those areas of common or public access faced by the structure.
(d) In any civil action arising under this section, the court may award costs and reasonable attorneys' fees to the prevailing party. (2007 279, s. 1; 2009 553, s. 1.)

Other Statutes and Explanations:

§ 160A-400.4 Designation of historic districts
§ 160A-201, § 153A-144 Limitations on regulating solar collectors
§ 22B-20 Deed restrictions and other agreements prohibiting solar collectors
§ 105-277 Property Classified for taxation at reduced rates; certain deductions
§ 105- 275 Property classified and excluded from the tax base

General statute 160A-400.4 Deals with the designation of historic districts. Part D of this statute applies the provisions found in GS 160A-201 to zoning or other ordinances pertaining to historic districts. This provides that solar collectors cannot be explicitly restricted, but ordinances can be created to regulate the location or screening of solar collectors

GS 160A-201 and GS 153A-144 both restrict a city or county from creating an ordinance that would prohibit or have the effect of prohibiting the installation of a solar collector Section B of both of these statutes allows for the creation of ordinances that regulate the location or screening of solar collectors

GS 22B-20 is similar to GS 160A-201 and GS 153A-144 except for it applies to deed restrictions and covenants that may prohibit the installation of solar collectors

GS 105-277 states that properties with solar heating/cooling systems cannot be taxed additionally because they have these systems as opposed to a regular HVAC system. These properties must be taxed at the same rate as those with HVAC systems

GS 105-275 details what properties are classified as a special circumstance and thus excluded from the base and not subject to extra taxation (as noted previously and as provided for by the North Carolina Constitution Article V Section 2 (20)

§ 105-164.14B Certain industrial facilities refunds
§ 105-129.16A Credit for investing in renewable energy property
§ 105-129.16I Credit for a renewable energy property facility
§ 105-129.15 Definitions (for business and energy tax credits)
§62-133.8 Renewable and Energy and Energy Efficiency Portfolio Standards (REPS)
§ 62-82 Special procedure on application for certificate for generating facility; appeal from award order

The General Statutes indicated above do not pertain to the placement, location, or prohibitions on solar collectors in residential areas. Rather, these statutes apply to tax credits and manufacturing facilities. The tax credits mostly apply to non-residential areas.