Energy Efficiency, Renewable Energy and Historic Preservation:

A Guide for Historic District Commissions

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Illustrations by Emma Armstrong

Forward

Clean Air-Cool Planet is a non-profit organization in Portsmouth, NH that works to find practical solutions to the global climate change problem through civic engagement, education, and effective policy. Clean Air-Cool Planet works with Local Energy Committees (LECs) in numerous New England communities, and often fields questions regarding the treatment of historic resources in these towns. This guide is an attempt to answer these questions, by starting a conversation between communities of experts in preservation and energy efficiency.

This guide was authored by Meg Giuliano, LEED AP, a fellow in the Clean Air - Cool Planet Climate Fellows program, with Anne Stephenson, PhD, LEED AP, BPI building analyst and HERS energy rater, who manages the Climate Fellow Program.

Ms. Giuliano was a master's candidate in Environmental Management at Duke University during the summer of 2009, while working on this guide as part of her Climate Fellows Program project.

INTRODUCTION

Pushing for energy efficiency

As energy prices rise and concern about climate change grows, building owners across the country have been eager to learn about how they can improve the energy efficiency of their homes and businesses.

Without switching fuels or making major changes to infrastructure, there are a number of simple (and relatively inexpensive) things that people can do to decrease energy use without lowering quality of life. Many efficiency investments will even pay significant dividends throughout the lifetime of the building. In New England, where winters are cold and long, there has been an active movement towards weatherization and energy efficiency in buildings of all shapes, sizes, and ages.

New England town greens form the center of many historic districts.

Recently introduced "green building" requirements call for higher standards for energy efficiency in *new* buildings in many places, but not many communities apply these principles to existing buildings. Because older buildings represent a large portion of the residential sector throughout the U.S. – and especially in New England – we need to find ways to make them more efficient. Some places are exploring incentive programs and new code structures to encourage this, but there is still a lot of work to be done.

Fossil fuels are only a short-term solution

Since the Civil War, most New Englanders have heated their homes and fueled their daily activities with oil, gas, and coal. Today, for several important reasons, it is evident that we cannot continue to depend upon these fossil fuels for our energy needs. Fossil fuels are finite resources that will only become more expensive as their supplies dwindle. We need to start using these fuels more efficiently, while simultaneously transitioning to an alternatively fueled economy.

Additionally, it is now clear that the climate is changing as a result of human activities. Burning fossil fuels increases the atmospheric concentration of greenhouse gases, causing irrevocable changes in the climate. In New England, climate change is already impacting our natural resources and the economy. Rising temperatures have shortened the winter recreation season, and have the potential to affect fall foliage (an important tourist draw) and the maple syrup industry. Lastly, although there are fossil fuels that can be found within our national borders, the United States has also come to rely upon other nations for our energy supply. While complete energy independence seems unlikely in this global market, it is important to our national security that we become more self-sufficient in providing for our national energy needs.

New England's very oldest buildings were not built to be powered by fossil fuels. These systems were added by twentieth century residents during a time when energy was cheap. Now, as twenty-first century citizens, we need to re-engineer the built environment and begin to decrease greenhouse gas emissions aggressively.

By the Numbers

In the United States, the residential sector uses 21 percent of all consumed energy. This includes energy use for heating and cooling in homes, as well as electricity. In New England, nearly 30 percent of occupied dwelling units were built before 1939. This is more than twice the national average for this age category, which is about 14 percent.

Most New England towns are dense and walkable.

Energy efficiency CAN be achieved without compromising historic building stock

In New England, the historic character of our communities attracts visitors and helps to sustain our economy. Careful stewardship of older homes and buildings helps to create a distinct sense of place, and learning about local history connects people to their community.

It is a commonly held misperception that paying high energy bills is the "cost of doing business" for historic property owners and caretakers. Modern technologies and weatherization procedures allow significant improvements to buildings without compromising the historic value of the structure. With that said, it is important to strive for whole-building solutions that address each building's unique situation in an intelligent, cost-effective, and historically sensitive manner.

Greening the Historic District

Traditionally, historic districts have not been viewed as particularly "green" neighborhoods. Older houses and municipal buildings have a reputation for being drafty and inefficient, and unfortunately this is true in many cases. However, it is also true that existing buildings contain a large amount of embodied energy*. Restoring them is usually more environmentally efficient than building new ones, especially after they are retrofitted with energy upgrades. In addition, the dense development and inherent walkability in many historic neighborhoods allows residents to be less dependent upon their vehicles – a distinct environmental advantage.

The first part of this document is directed towards commissioners of historic districts across New England, and the second part is written for owners of historic homes. By bringing sustainability and historic preservation professionals to the table together, we hope to help New Englanders save money and energy, conserving natural resources, protecting the climate and preserving our irreplaceable historic buildings in the process.

* The energy used in the extraction and production of the materials used and existing, as well as in the construction, of the original building.

What does "sustainability" mean?

In 1983, the U.N. World Commission on Environment and Development published a definition of sustainability that is now widely used throughout the world: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Sustainability requires that people think about how much of a resource is available now, and how much there will be in the future.

PART 1: FOR HISTORIC DISTRICT COMMISSIONS AND HERITAGE COMMITTEES

Overview

Part I of this guide explores the relationship between historic preservation and sustainable energy. It contains background information on the ongoing local energy movement, and suggests ways for Historic District Commissions (HDCs) to collaborate with the energy community if they haven't yet had the opportunity. Ultimately, we need to return to the time before energy became so cheap that we took it for granted. In this, it seems that there exists a wonderful opportunity for a conversation between the community of experts in every New England town – local energy committee members, the historic district commissioners, preservation specialists, and energy professionals.

How can the preservation community be a part of the answer?

There is a lot of talk these days about "going back to the old ways." Many of the technical solutions that have been embraced by the "green" movement are based upon simple principles. While these strategies take advantage of the newest scientific achievements, they emphasize old ideas: closed-loop cycles, connection to nature, use (and reuse, and recycling) of renewable resources, and conservation.

Over time, we have forgotten some of the things we used to know about how to live sustainably on this planet. Before the advent of cheap fossil fuel energy, people constructed homes using "passive solar" design. Consider colonial saltbox houses, common in New England in the 18th century. Settlers built these homes facing south, towards the winter sun and away from winter wind, with few or no windows on the low north wall. The low, sloping roof carried cold north winds up and away from the building, and overhangs shaded the front windows during summer. Deciduous vegetation shaded and cooled the house during the warmer seasons, but allowed sun through bare branches to heat the house in the winter. A few hundred years ago, people knew (first-hand!) the true cost of energy, as they harvested wood fuel and chopped it themselves, before burning it to heat their homes.

New England saltbox – building with climate and energy in mind.

Now, we are re-learning some of those old ways, and, we hope, improving and building upon them. Passive solar orientation is a major component of LEED, today's most widely used green building certification system. Biomass, produced in sustainably managed woodlots and burned in super-efficient pellet stoves, is becoming popular again as a source of heat in the winter. To some, these ideas seem new and fantastic. But the members of the preservation community – as keepers of local history – remember that people have known many of these things for a long time. It will be important for historians and preservationists to share their experience, ideas and knowledge as we move forward into the next stage of our energy future.

Smart Growth and New Urbanism

In this age of sprawl, the smart growth and New Urbanism movements link environmental concerns with community-building ideas, economic development, and connection to place. These movements are attempting to bring back pedestrian-based community planning, reducing greenhouse gas emissions and creating a more sustainable model for human cities and towns.

Read more about smart growth:
http://www.smartgrowthamerica.org/whatissg.html
For more on New Urbanism: http://www.cnu.org

Working together to weatherize New England

New Englanders have always been known for their "Yankee thriftiness" and creativity in the face of difficult environmental conditions. We have weathered severe storms before, and we can do it again – but only with all of the interested parties around the table.

We need preservationists to join the energy efficiency conversation. It is important that we find new ways to weatherize old homes, balancing the immediate need for energy efficiency with the thoughtful process demanded by preserving historic character. Every old house is different, and there are a lot of individualized concerns to keep in mind.

A charette at Strawbery Banke brought local energy experts to meet with preservationists.

The preservation community has a great deal of experience to share with energy professionals. For example, it is clear to preservationists that a solid one-piece aluminum window (with a life-span of only fifteen years) is NOT a sustainable solution, no matter how energy efficient it is. We need to remember the old ways again; repairable products last much longer, and keep money in the local economy by valuing labor and creating jobs for craftspeople and skilled workers. There are many, varied benefits of a "repair instead of replace" culture.

In return, the sustainable energy community has resources to share with the preservation community, as well as a sense of urgency. They accept that climate change is occurring, and know that we need to act fast to avoid the harshest of potential impacts. New green building ideas and techniques are, in fact, applicable to the world of historic structures.

The Local Energy Scene: What's happening in your community?

Many New England towns and cities have already recognized the need for local action within the greater national movement for energy transformation. Responding to climate change and volatile fuel costs, communities in our region have signed on to several important national and international climate change agreements. Some have committed to specific levels of greenhouse gas emissions reductions over the next decade, and in many cases, towns have formed new groups and committees to address these complex issues. These groups differ in size and organization from town to town, but in New England, most are called Local Energy Committees (LECs), also known in some places as "green teams," "energy task forces," or "sustainability committees." There are hundreds of LECs in New England, and they are the community energy organizations whose initiatives typically overlap with the work of HDCs. This part of the guide focuses on the relationship between LECs and HDCs.

2009 Local Energy Committee Conference

The Greenest Building….

Both the environmental and preservation communities have recently embraced the concept of life-cycle assessment, or LCA. LCA considers the lifetime environmental (or economic) impacts of a product or service. When applied to buildings, LCA tells us that the costs of demolishing an old building (losing the embodied energy it contains), plus the costs of constructing a new one in its place, are far higher than those associated with upgrading the original structure. Embodied energy refers to the energy costs associated with the extraction and production of the materials and construction of the original building.

Sustainable Lexington (MA):
Sustainable Lexington works to influence the town and its residents toward environmental sustainability – meeting the needs of today's residents without compromising the ability of future generations to meet their own needs. We focus particularly on opportunities that will save Lexington taxpayers money. Our work includes education, working with town government, pilot projects, and supporting Massachusetts educational and policy efforts.

Plymouth Area Renewable Energy Initiative (NH):
The Plymouth Area Renewable Energy Initiative was organized to encourage energy conservation, energy efficiency practices and to promote the use of renewable energy in homes, businesses and public buildings in the Plymouth region through education community outreach and barrier reduction. The Energy Initiative takes a pragmatic approach by encouraging people to prepare for their energy future as they would their financial future. Our guiding motto is Get Energized. Plan Now for Your Energy Future.

Marshfield Energy Committee (MA):
To serve the residents by recommending energy and alternative energy policies that will reduce energy consumption and greenhouse gas emissions in the Town of Marshfield.
For more resources on LECs visit: http://www.carboncoalition.org/community/EnergyCommitteesResources.php

In general, the mission of an LEC is to reduce greenhouse gas emissions by promoting energy conservation, energy efficiency, alternative energy implementation, and environmental sustainability in municipal affairs. LECs support the town in a variety of ways, and will usually begin by completing initial research and a greenhouse gas inventory for municipal activities. Next steps typically include setting short- and long-term energy goals for the town, improving methods of communication for project members and stakeholders, creating practical strategies, and encouraging their implementation.

LECs have been involved in a number of different climate- and sustainability-related initiatives, and it can be confusing to figure out which organizations do what, and where historic buildings fit into the puzzle. Here is a brief primer:

If your historic district is located in a New England city of 30,000 or greater, there is a good chance that your Mayor has signed the Mayors' Climate Protection Agreement (MCPA). There are three main tenets of the Agreement, which pushes cities to "meet or beat" Kyoto Protocol requirements. The Agreement also asks cities to put political pressure on state and federal governments to do the same, by enacting appropriate, aggressive climate change legislation.

The Mayors' Climate Protection Agreement is currently supported by 944 mayors, including 73 from the six New England states. For more information, check here: http://usmayors.org/climateprotection/agreement.html

The Kyoto Protocol
The Kyoto Protocol is an international climate change agreement, which sets binding greenhouse gas reduction targets for industrialized countries that have ratified the Protocol. The targets average out to CO2 reductions of five percent of baseline levels (CO2 emissions as of 1990) over a five-year period from 2008 – 2012. The environmental treaty was adopted in December of 1997, and came into force in 2005. As of the beginning of 2009, 183 parties had ratified the treaty, not including the United States of America.

ICLEI, Local Governments for Sustainability is an international effort to bring local governments together with national, regional, and local governmental organizations that have made a commitment to further sustainable development and reduce greenhouse gas emissions. ICLEI provides resources and support for its member towns and cities, including carbon accounting software, consulting services, and training.

Today, ICLEI has over one thousand members, located in 67 countries across the world, including a significant number of communities in New England. More information can be found on their website: http://www.iclei.org/

According to the Sierra Club website, a "Cool City" is one that has signed the Mayors' Climate Protection Agreement (see above), signifying its commitment to reduce greenhouse gas emissions and improve sustainable practices in the community. The Cool Cities campaign encourages local action against climate change, and member cities are located across the country. All Cool Cities are profiled on the organization's website, found here: http://www.coolcities.us/. While Cool Cities doesn't provide support directly to towns with fewer than 30,000 residents, many of the ideas on their website could easily be applied in smaller communities.

How will LECs and HDCs work together?

Municipal Buildings and Businesses

Most LEC mission statements include language promoting energy efficiency improvements in municipal buildings, many of which are located in historic districts, although they may be exempt from HDC review.

Downtowns

Motivated by economic, social, and environmental concerns, many New England communities are embarking upon ambitious downtown revitalization projects. Some of these projects may come in front of the HDC, since a significant portion of downtown buildings can be found in locally designated historic districts.

Many New England towns boast vital downtown shopping districts.

Residences

Some Local Energy Committees conduct residential outreach on energy issues and have created programs to encourage private residents to weatherize their homes. Many homeowners in historic districts are approaching their local HDCs to ask about restrictions and allowances, as they prepare to install renewable energy systems, upgrade insulation, or change their heating or electricity infrastructure.

Zoning and Building Code Changes

Many municipalities are considering the adoption of building codes and zoning requirements that contain more stringent energy efficiency provisions than those currently applied throughout most of New England. Some of these might contain exceptions for historic buildings, while others do not; it is important for HDCs and homeowners to understand current codes and zoning laws as they pertain to building projects.

ARRA Funding

The American Recovery and Reinvestment Act of 2009, or ARRA, provides funding for low-income citizens to weatherize their homes. Because ARRA constitutes federal money, its apportionment automatically triggers Section 106 review, under the National Historic Preservation Act of 1964. It is expected that State Historic Preservation Offices (SHPOs) will be dealing with an increased number of project review requests in the near future, and is important that the local HDCs be aware of the potential upswing in housing weatherization projects.

How can your Historic District Commission get involved?

The National Trust for Historic Preservation and the Friends of the National Center for Preservation Technology and Training jointly announced the Pocantico Proclamation on Sustainability and Historic Preservation in November, 2008. The proclamation calls upon the preservation community to address the "global human-caused ecological crises that threaten our built and natural resources," asking policy-makers to recognize three imperatives: climate change, economics, and equity. The writers state that they "stand ready to offer an example for sustainability," and ask preservation leaders as well as fellow citizens to take immediate action.

As historic preservationists, your expertise in building stewardship is invaluable to your community. Increasing the sustainability of our existing built environment is vital, and we need to start right away. It is imperative that all homeowners begin efforts to improve the energy efficiency of their homes. You are, as historic district commissioners, acquainted with the particulars of the local building stock, and well-versed in architectural history and restoration techniques. This puts you in a great position to be proactive and involved in the energy efficiency movement in your town.

We suggest the following actions:

Work with you Local Energy Committee (LEC). Sit down with the people on your local LEC to review the local historic district ordinances to understand their mutual value in both protecting the historic fabric of the community but also how it might be used in support of energy efficiency.

Promote weatherization efforts in your community, using your expertise in building science, knowledge of town history, and understanding of codes and local government structure.

When people come to you for permits or advice, actively encourage them to make their homes more energy efficient. Help them understand that there are ways to realize cost-effective, whole-building solutions that both keep the historic fabric of their home intact AND improve the energy performance of the building. Research new historically sensitive weatherization practices and materials, and promote these to your constituents.

Use the historic district to demonstrate traditionally "green" practices (passive solar siting, strategic roof pitch, smaller house design, the use of local building materials); show well-designed historic buildings as examples for new construction in town. Hold public workshops and tours for community members, highlighting projects that successfully conserve both historic resources and energy. Invite experts to speak with your constituents, or set up a table at a public event.

Have a member of the HDC join your town's existing LEC, or if there isn't one, consider spearheading its formation. Openly discuss common goals of the HDC and those of the LEC regarding energy efficiency and resource conservation. Invite representatives from your town's LEC to your next HDC meeting to discuss areas of joint concern. Or, help to create an LEC in your town if you don't have one. Clean Air-Cool Planet and the Carbon Coalition have published two handbooks to help communities take action against climate change by forming LECs. You can find them at http://www.cleanair-coolplanet.org/for_communities/energyguide.php

What else can HDCs do?

Consult with your local library about purchasing books about home weatherization and energy efficiency, or about donating a watt-meter they could loan out. This is a simple and inexpensive action with a lot of potential. We suggest the following book titles:

- *Climatic Building Design: Energy-Efficient Building Principles and Practice,* by Donald Watson and Kenneth Labs
- *The Homeowner's Handbook to Energy Efficiency,* by John Krigger and Chris Dorsi

Many libraries now include residential-scale electricity meters in their collections for homeowner self-audits. If your library does not have a watt-meter, consider giving one, such as the "Kill-a-watt" meter, made by P3 International.

Include a "Sustainability" section or page on your HDC's website. This is a great way to let people in the community know that you have been thinking about the HDC's role in the sustainability movement. On this page, you can include information about green preservation, weatherization, building codes, or anything else you deem appropriate. For a great example, see the California SHPO's website, at http://ohp.parks.ca.gov/?page_id=24592

Start a Carbon Challenge. Get your neighborhoods and constituents excited about energy efficiency and challenge them to reduce their household carbon footprint. Partner with your local library and put up an informational website, or advertise in the local paper. Carbon challenges are great educational tools, and can be quite effective at reducing emissions. There are lots of resources out there, and you might even be able to join a pre-existing competition, depending upon your town's location. For more information, visit www.nhcarbonchallenge.org/.

Learn the language of LEED. LEED (Leadership in Energy and Environmental Design) is a program of the U.S. Green Building Council (USGBC). It is currently the most widely used green building certification program in the world. LEED programs include schemes for certifying new construction, schools, existing buildings, and most recently, neighborhoods. Encourage your colleagues to familiarize themselves with the USGBC website, or take a short class to get familiar with LEED. Green building language is being incorporated into codes around the country, and many towns and cities are thinking about using the LEED system for municipal construction projects. For example, the town of South Berwick, Maine is considering a LEED certified historic adaptive reuse project – a c. 1900 Catholic church will be the new town library. The historic district commission, library board, and energy and building committees have all had to become familiar with green building terms and practices. Visit www.usgbc.org/leed/ to learn more about the USGBC and LEED.

Write a letter to the local paper. Once you begin to work with your LEC in earnest, let your town know what's going on. Send a letter to the editor to the local paper, highlighting HDC-LEC teamwork, and encouraging residents and business owners to begin the energy efficiency process.

CASE STUDIES

A working partnership

Nantucket, MA: Historic-Green Committee

Known for its picturesque architecture and well-preserved historic character, Nantucket Island is a popular coastal destination for visitors and summer residents from all over the country and world. Nantucket is also home to a sizeable year-round population of residents, many of whom have long-standing ties to the island. The people of Nantucket have recognized that natural resource conservation and long-term sustainability are essential to the island's continued vitality, and have started a lively conversation about energy efficiency, renewable energy, and the preservation of Nantucket's historic building fabric.

Nantucket's unique historic architecture is known throughout the world.

With the support of Clean Air-Cool Planet and Sustainable Nantucket, two non-profit organizations concerned with climate change mitigation, Nantucket residents have formed a "Historic-Green Committee," made up of Historic District Commission (HDC) members, local builders, renewable energy professionals, architects, restoration specialists, LEED accredited professionals, and homeowners. The primary goal of the Historic-Green Committee is to produce a sustainability-focused addendum to *Building with Nantucket in Mind*, a comprehensive architectural history and construction guide for the island.

The addendum, included as an appendix to this guide, addresses windows and and door weatherization, solar energy technologies, wind turbines, alternative roofing and siding strategies, rainwater capture, and landscaping. This information will help residents to embark upon projects that increase energy efficiency and the use of renewable technologies, while also maintaining the historic integrity of individual buildings and the island. Nantucket hopes that these guidelines will serve as models for other HDCs in New England.

A historic museum setting the bar for innovation

Portsmouth, NH: Strawbery Banke Museum Climate Inventory and Mini-Charrette

The Strawbery Banke Museum campus features more than 30 historic buildings from different time periods, in a landscape of restored historic gardens. Visitors to the museum have the opportunity to connect to the past in very real, meaningful ways, as they explore the neighborhood of Puddle Dock, which was saved from an urban renewal project in the 1950s. Buildings have been restored to different time periods, representing four centuries of New England life. Some have been preserved, and others have been adapted to new functions; there are a number of former houses that now hold exhibitions of artifacts and material culture, and several buildings serve as rental property, including an art gallery and an upscale restaurant.

Strawbery Banke has partnered with Clean Air-Cool Planet to complete a greenhouse gas inventory of its operations and develop an emissions reduction plan, and is one of the first historic museum complexes to do so. The museum intends to improve the energy efficiency of its buildings, thereby decreasing energy-related expenditures as well as carbon emissions. With the help of a Clean Air-Cool Planet Climate Fellow, Strawbery Banke is also creating interpretive materials around the project, to teach museum-goers about efficiency, sustainability, building science, and energy use throughout New England history.

As a part of the data-gathering process, Strawbery Banke and Clean Air-Cool Planet hosted a design charrette for the Rider-Wood House, one of the museum's historic house exhibits. Rider-Wood was built in 1780, and holds a number of period artifacts and pieces of furniture. The museum's goal is to retrofit the building for maximum energy efficiency while retaining its function as a historic house museum and protecting its historic fabric. A number of professionals attended the charrette, including energy efficiency experts, architects, energy auditors, historic preservationists, museum staff, and a restoration specialist. The decisions of the group will be used to advise the museum on how to proceed with the energy renovation project.

Overview

Part II of this guide is divided into two main sections. The first section presents a series of general "Frequently Asked Questions" regarding energy efficiency projects in historic houses. The second section, "Useful Questions to Ask the Experts," is a compilation of questions that you should be sure to ask your contractors and historic district commission officers as you plan your energy efficiency upgrades. Because every historic home is different, no single renovation strategy is a solution for all homes. These questions and accompanying explanations will, however, prepare you for how to best develop an energy strategy for your home. We have selected the following questions from actual questions asked of building experts and HDCs across New England. At the end of this section, we have also included an energy efficiency checklist, containing suggestions for actions all homeowners should take, which will help to reduce both energy use and greenhouse gas emissions.

Frequently Asked Questions

Is it true that historic buildings are less efficient than others?

Landscaping for passive cooling is just one of many simple, and traditional, New England solutions.

Historic buildings often have siting advantages that other buildings do not enjoy. Because they were built before the era of cheap energy, older homes were designed to take advantage of the sun, with large south-facing windows and smaller northern ones. Vegetation was planted strategically. Many of New England's older deciduous trees still survive in historic neighborhoods, shading houses in summer and allowing the sun to shine in through windows in the winter. Historic homes located in town have better access to public transportation, and are within walking distance of local businesses and other amenities.

Despite all of these advantages, historic homeowners know that most old houses are in need of maintenance and updating. Depending upon the age of the building, your house may not have been heated by fossil fuels in its original state. It could have been warmed by fireplaces and woodstoves, and it was probably retrofitted with its current energy system sometime within the last century. Some older buildings lack insulation entirely, and yes – these buildings are less efficient than well-designed new buildings.

Although your older building might boast more than a few traditional energy-efficient features, there may also be a number of projects that you could do to improve its performance, saving yourself some money as a result.

Why should I upgrade the energy system in my home? Why is efficiency important?

Northern winters are long and harsh, and in recent years it has become more expensive to heat our homes, especially during the coldest four months of the year. As New Englanders, we also pay some of the highest electricity rates in the country, contributing to large annual energy expenditures. Whether you are motivated by lowering your energy bills, reducing your carbon footprint, or conserving natural resources, there are a number of benefits that result from enhancing your home's overall energy performance.

Improving your home's energy efficiency is the first step in any energy upgrade project. The more efficient your building is, the less energy you will need to produce to keep it livable. A tightly insulated home with smoothly running heating and cooling systems will save you a lot of money in the long run, and produce fewer greenhouse gas emissions. Similarly, conservation behavior and the use of more efficient appliances and equipment will decrease your electricity bills.

As the owner of a historic building, what should I keep in mind when starting to think about an energy efficiency retrofit?

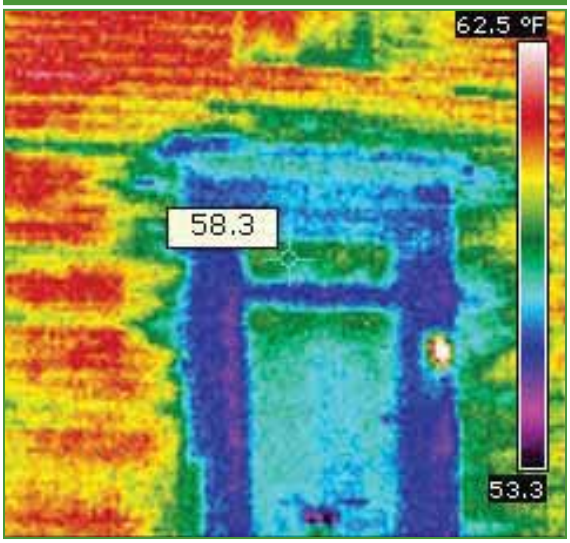
1) It is important to work *with* your historic district commission, not against them. Consult the HDC early on in your process, and be aware of any restrictions that might apply to your particular project. Consider reversible solutions, rather than alterations that could harm the historic fabric of your building.

2) All older buildings are different. Be sure to take steps to learn about your house and its special quirks. Hire a building science or preservation consultant if necessary – it will save time, money, and frustration later if you have a thorough understanding of your building before you begin major work.

3) The "order of operations" for your renovation project is very important. Which improvements should be completed *first*, or before other steps (i.e. insulation before windows, efficiency before renewables)? Which projects must be accompanied by other, related ventures? What is the most cost-effective approach, and what is your payback time on each system? Remember to develop "whole-building" solutions and use system-wide thinking when planning your renovation strategy.

What is an energy audit? Should I be afraid to get one? If we hire an energy auditor, what certifications should the auditor have?

Infrared (thermal) image of a leaky doorframe.



Homeowners hire an energy auditor when they want to learn more about how their house uses energy for electricity, space heating, and cooling. An auditor comes to the home with specialized equipment and spends several hours assessing the energy systems in the house. At the end of the session, the auditor identifies potential problem spots, provides suggestions, and writes a summary report for the homeowner.

If you are considering an energy audit for your historic home, you may already suspect that your house would benefit from additional weatherization or energy efficiency measures. The initial added cost of an audit is almost always recovered within a short amount of time after implementing efficiency strategies – the information gained through the audit process will help you make more cost-effective decisions and prioritize home improvement actions in ways that make the most financial and technical sense. As the owner of a historic house, you might face issues that are unique to your particular building, and the more information you have about your home's energy performance, the more smoothly the process will go. An audit is also a good idea for establishing baseline building performance data, so you can assess the success of your energy improvements as you begin to work on your house.

So, no – you should not be afraid to get an energy audit. If you arrange an audit for your house, it does not mean that you have to proceed with suggested renovations right away. All it means is that you are armed with more information, and when you are ready to start work on your house, you can do it in a well-educated, intelligent way.

When hiring an energy auditor, you should look for someone with HERS (Home Energy Rating System) Energy Rater or BPI (Building Performance Institute) Building Analyst certifications. Auditors are required to disclose any financial interests they might have in the results of your audit; many auditors are also contractors or vendors of efficiency products.

Although we recommend a professional audit before undertaking major renovations, there are many resources available to help homeowners perform a partial audit of home energy use. Your utility may offer a free walk-through energy audit; if this service is not available in your area, there are resources for homeowners to perform their own energy audits. Some libraries have watt-meters available for borrowing, so that you can assess the energy load of your appliances. While the self-performed audit does not give as much information as a professional audit, it's a great place to start.

Check out the following sites for more advice, and for access to home energy audit calculators:

Energy Star, Home Energy Yardstick: http://www.energystar.gov/index.cfm?fuseaction=HOME_ENERGY_YARDSTICK.showGetStarted

Lawrence Berkeley National Laboratory, Home Energy Saver: http://hes.lbl.gov/

U.S. Department of Energy: Energy Efficiency and Renewable Energy, Do-It-Yourself Energy Audit: http://www.energysavers.gov/your_home/energy_audits/index.cfm/mytopic=11170

New Hampshire Carbon Challenge: www.nhcarbonchallenge.org/

Who will be working on my house? How many different kinds of specialists and contractors might I need to deal with?

A guide to who's who:

Energy auditor – assesses the energy situation in the home using specialized equipment and expert knowledge, compiles a report of the findings, and suggests improvements in order of cost-effectiveness; also, can brief the homeowner on federal and state incentives for project financing.

Preservation consultant – an expert in historical resources; advises the homeowner on the best ways to protect a historic home during renovations and energy upgrades.

Building science consultant – helps involved parties understand complex, whole-building issues like moisture, ventilation, and insulation, and can give advice regarding the most appropriate solutions for each particular situation.

Building inspector – an employee of your town inspects the work being done and makes sure that everything is up to current building codes and meets local zoning laws; approves building and occupancy permits.

Historic district commissioner – oversees the historic district; reviews exterior alterations to homes and businesses located in the district and issues permits or certificates of appropriateness allowing renovations to proceed.

General contractor – contracts with the homeowner to oversee construction and renovation activities on the home; responsible for planning the project, and for supplying all labor, materials, equipment, and services; will sometimes engage subcontractors to take over part of this process.

Insulation contractor – responsible for installing insulation, and should be able to answer questions related to moisture issues and air sealing.

Renewable energy installer – installs renewable energy systems; depending upon the type of system, it might also be necessary to consult with a plumber or electrician

Window contractor – installs and refurbishes windows; can provide information about different types of windows, window materials, R-factors, etc.

HVAC technician – HVAC stands for Heating, Ventilating and Air Conditioning; the HVAC technician deals with the heating and cooling systems, and is responsible for ensuring acceptable indoor air quality, thermal comfort, and reasonable costs of installation, operation and maintenance (aka, heating and cooling contractor).

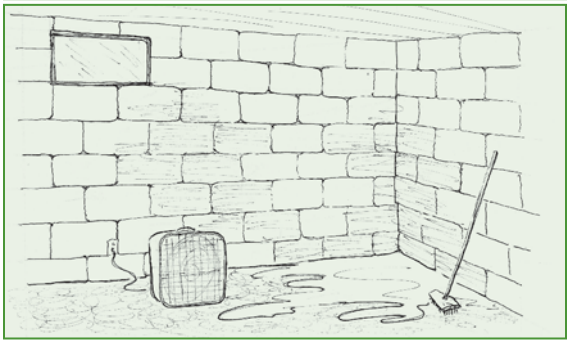
Landscaper – helps to plan energy-efficient landscaping.

USEFUL QUESTIONS TO ASK THE EXPERTS

Questions to Ask Your Contractor

How can I tell if I have a moisture problem and why does it matter in the context of weatherizing my home?

Many New England homes have damp basements.



Many older homes suffer from moisture problems, which can lead to issues with mold and mildew, indoor air quality, and peeling paint. Excess moisture in certain areas can also cause irreversible damage to the fabric of your home, as well as harm valuable historic materials. Whether or not you have pre-existing moisture issues, you should *definitely* ask your contractor about moisture at the beginning of any renovation project, especially if the work will involve air sealing, insulation, or ventilation. Be aware that your home could develop a post-renovation moisture problem that was not there before – this is why it is essential that you contract an expert who is knowledgeable about moisture management and willing to discuss it with you and the other people working on your house.

Before your contractor comes, you should search your house for signs of moisture problems. Look for water leakage (on ceilings, around windows), spotting on walls and ceilings, visible mold and mildew, peeling paint, and warping of materials. Take note of any unusual musty odors or areas that smell like mildew or mold. Check the basement, and look for wet areas, dampness, and standing water.

Your awareness of potential water issues will help the contractor formulate the best strategies for your home, as the renovation plan will need to address both moisture and energy efficiency simultaneously. Because weatherization and efficiency techniques often involve tightening up the building envelope and adding insulation to the walls, floors, and ceilings, there is a chance that moisture problems will be exacerbated if they are not dealt with first, or created anew if proper precautions are not taken.

Building Envelope

Also called a "building shell," the envelope of a building is made up of the foundation, bottom floor, exterior walls, and roof assembly. Each of these components generally has at least two faces with a cavity between.

What kind of insulation strategy should I pursue for my building?

The basic function of insulation is to conserve energy by slowing heat transmission. It does this by forcing heat to conduct through air or another kind of gas (gases are poor heat conductors), and by reducing heat radiation and air convection within cavities where it is installed.

There are lots of different ways to insulate, and your contractors can help you to decide which ones are best for your building. In planning an overall insulation strategy, you will need to determine:

1. **Where to insulate**

   Attic, basement, floors, ceilings, walls – these are all options, and some of them might already be insulated in your house. First you need to assess the current location, type, and amount of insulation present, and then your contractor will help you decide which additional areas will afford the most cost-savings when insulated, and be the most effective for your overall efficiency plan.

2. **What kind of insulation to use in each area**

   Insulation is made from mineral materials (glass, Vermiculite, Perlite) or organic materials (plastic foams, cellulose) that trap air and use gases to slow heat conduction. Product types include flexible materials (batts, blankets), rigid materials (foam and fiberboard), sprayed-on materials (polyurethane), and loose-fill (cellulose). These are differentiated by R-value, ease of installation, density, permeability, and ability to resist moisture, among other characteristics, and you should ask your contractor why he or she is choosing a particular insulation strategy for your retrofit.

R-Value

R-value is a measurement of thermal resistance, or resistance to heat-flow. Insulation has a particular R-value per each inch of thickness. When considering which type of insulation to install, it is important to know the R-value per inch, as well as the cost and installation method for each one.

Your auditors and contractors may have suggestions about whether or not to isolate your basement and/or attic from the building. If you don't include the basement in the building envelope, you should consider insulating and wrapping any pipes and ductwork that are in the basement. Ask your contractors and auditor about this.

Though the HDC does not regulate interior renovations, you should consider the effect that the different insulation techniques will have upon the historic fabric of your home. For example, some insulation methods involve drilling holes in the side of the house or removing clapboards. Ask your contractor and preservation specialists about the best ways to avoid damaging the historic materials of your building during this process.

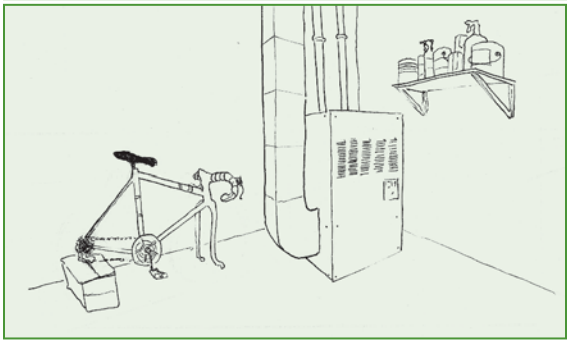
I've heard that retrofitting older homes with insulation can lead to serious moisture issues. While my heating bills are high, my daughter has asthma and I don't want to make my home unhealthy for her. How can I insulate while protecting our health?

It's true! It is not prudent to formulate an insulation strategy without addressing the moisture situation in your home, because tightening up and insulating the building envelope can trap moisture in places where it is not supposed to be. This can lead to mold and mildew problems, lower your indoor air quality, and cause damage to your home.

However, it IS possible to insulate an older home safely – just make sure that your weatherization plan also contains provisions to control moisture. Your family's health is very important, and you should probably consult a building science expert as well as your contractors, so that you can formulate a comprehensive, whole-building solution for your house.

My furnace is not a new model, but it had a fairly good efficiency rating when I bought it in 1996. How do I determine if an upgrade will achieve enough in energy savings to make the investment worth it?

A furnace upgrade may present a significant energy saving opportunity.



This is actually a question that your auditor might be able to answer, but if not, you should ask an HVAC contractor. There are some straightforward calculations that energy professionals can make to compare current energy costs to potential savings gained by installing a new system. They will usually calculate the "payback period" for a particular energy solution, which is the amount of time it will take to recover the costs of a new system before you start saving on your bills. Additionally, your energy professional will advise you if there are tax credits or rebates that will alter the payback period.

Furnace technologies have improved since 1996, so you might benefit from an upgrade. There are lots of different options out there today that might be worth looking into, including wood pellet boilers, co-generation systems, and modern high-efficiency condensing furnaces. These options are appropriate for nearly all homes, including historic ones like yours.

If an upgrade does not make sense at this time (or even if it does!) you should definitely consider asking your contractor about options for boiler controls. There are several interesting energy efficiency retrofit technologies that significantly increase the efficiency of your boiler (within your current furnace), and quickly pay for themselves. For example, outdoor reset technologies are a great option. These can save anywhere from 5 – 30 percent of your energy expenditures with your existing heating system, by continuously adjusting your boiler temperature to match outdoor conditions, instead of allowing it to run at a constant high temperature all the time.

My house is drafty. How can I tell where the air leaks are coming from? How do I decide where to seal first?

Drafts usually come from multiple locations.

Air leakage is one of the things that auditors usually test during an assessment of a building, so you should be certain to mention the presence of drafts to your energy auditor. He or she might even ask you to identify some of the draftiest places in the house before or during the audit. Drafts occur because of unsealed gaps in your building's shell, where outdoor air and indoor air can mix. These often-invisible openings make occupants uncomfortable, and they are costly, energy-wise. It is possible that you are wasting up to 30 percent of the energy consumed by your home heating and cooling equipment through air leaks in your building envelope.

The energy auditor will perform a blower-door test to identify the leaky areas in your home. A blower-door is a canvas door and fan apparatus that is temporarily inserted into an outer door of your home. Your auditor will ask you to close all of the other doors and windows, before using the fan to depressurize the house by drawing the inside air out through the fan opening. This will, in turn, cause air to come in through any openings to the outside, including cracks around other doors and windows, fireplaces, unsealed outlets, and any other hole or opening to the outside. The auditor will then walk through the house with a thermal camera, which measures air leakage using infrared technology, and he or she will make careful notes of the places that need sealing as well as their relative leakiness.

Ideally, a well-sealed home will have a continuous air barrier accompanied by adequate insulation. There are many ways to seal up the cracks once you have identified them in your audit, and your energy professional can help you understand how to eliminate the most significant leaks in your home, as part of your efficiency upgrade.

I have exposed ledge in my basement. Does that change my insulation or air sealing options?

Exposed ledge – bedrock, in other words – might mean that you have an unsafe amount of radon in your basement. You should have radon levels assessed and mitigated before proceeding. Ledge is also a direct conduit for ground water to enter your basement. Many building scientists have found that the best solution is a polyethylene ground-moisture barrier, sealed above the ledge, which is then foamed with insulation. Make sure your contractor knows about the ledge in your basement, and ask him or her to explain how the ledge affects their insulation plan.

What do I need to know about environmental hazards like radon, lead, and mold as I think about renovating my house?

RADON — is a naturally occurring radioactive gas that comes from decaying elements in the soil. It is colorless, odorless, and tasteless, and has been considered a carcinogen in humans. Radon can get into almost any home, and usually moves from the soil below your house to the air above, coming through cracks and gaps in the foundation and building shell. Testing is inexpensive and easy, and you should ask your contractor about it. For more information, check here: http://www.epa.gov/radon/pubs/citguide.html

MOLD — may also be an issue in your home, and goes hand in hand with moisture problems. Because mold grows where it is wet, if you manage your moisture properly, you will usually take care of your mold problems. See here for more information: http://www.epa.gov/mold/moldguide.html

LEAD — is a toxic metal that can be very harmful to children, especially those under the age of six. In the past, lead was used in a number of common household products and materials, and lead-based paint is commonly found in homes built before 1978. Federal law now requires that "anyone performing renovation, repair, and painting projects that disturb lead-based paint in pre-1978 homes, child care facilities and schools follow lead-safe work practices." You should ask your contractor about lead hazards, and take the proper steps to protect your children by having them (and your house) formally tested. More information here: http://www.epa.gov/iaq/lead.html.

If I install additional attic insulation, will I need to install wall insulation to achieve the projected energy savings?

In this case, one solution does not presuppose the other. Many owners of older homes with original plaster and lath in place find it prohibitively expensive to retrofit wall cavities with insulation. About half of the heat loss in the average home is from the attic and basement, and solutions in these spaces can be cheaper and more easily reversible than wall solutions. In many situations, attic insulation can be installed to a level of R-40 or greater, achieving bigger energy savings for less money than a typical wall insulation retrofit. Ask your contractor to help you understand your home's unique circumstances.

Are there lower-cost passive or landscaping solutions to some of my heating and cooling issues?

Pergolas are a pleasant way to cool a house.

There are many things you can do to improve the passive heating and cooling properties of your house. "Passive" energy measures refer to strategies that do not require the use of an active mechanical system. Depending upon the siting of your home and your landscaping situation, you may be able to plant certain types of vegetation near your house that will help to shade it from summer heat, but allow winter sun to help warm it. You can consult with a landscape architect or green building professional to ask about these possibilities.

In addition to landscaping (and depending upon the requirements of your Historic District Commission) you may be able to install window awnings or shades, which will also help to manage solar heat gain. Other cooling strategies include installing pergolas or other shade-pockets near the home that cool the yard, and subsequently, the home.

QUESTIONS TO ASK YOUR HDC

Is my house in a national, state, or local historic district? What are the regulations for the district? Are there neighborhoods or buildings in town that are more highly regulated than others?

These are important questions to ask your Historic District Commission. Before undertaking any renovation or energy retrofit projects, you should have a full understanding of any historic districting requirements that might apply to your property. For example, some historic districts are zoned differently than surrounding neighborhoods, and special permitting processes or construction restrictions may apply to homes located on historic blocks. In many cases, building projects in historic districts must go through the HDC for review, and sometimes regulations prevent building owners from making renovations that will alter the appearance of the home's façade or visible landscaping.

You should also be aware of whether or not your building is listed individually on a national or state register. You can check here to see if it's on the National Register of Historic Places: http://nrhp.focus.nps.gov/natreghome.do?searchtype=natreghome. Additionally, each state has its own State Historic Preservation Office (SHPO), which is the government entity responsible for managing the state's historic resources. Some states also have their own register of historic places, in addition to the National Register, and your SHPO will be able to tell you if your house is listed.

In most cases, property restrictions on historic buildings stem from local regulations. National districts do not restrict homeowners and state listings may or may not come with property restrictions.

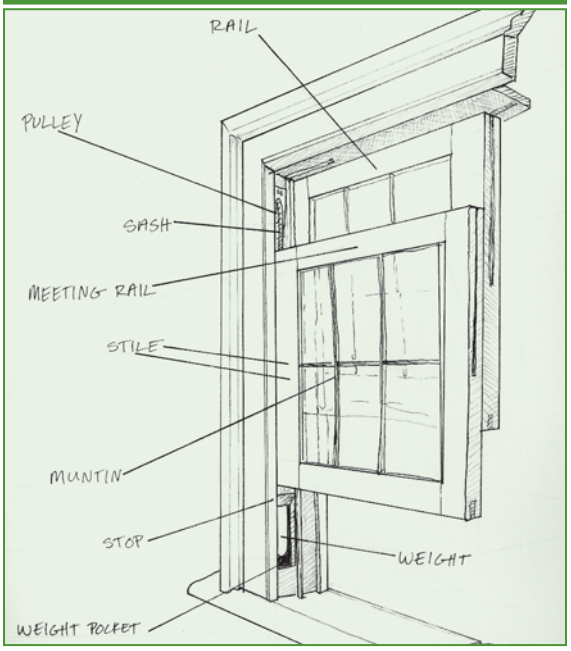
Properties in the historic district are considered either "contributing" or "non-contributing," and in some communities, the regulations differ between the two categories. A contributing structure "adds to the historic associations or architectural qualities for which a property or district is significant," while a non-contributing property does not increase the historic value of the area.

Are there contractors in the area who have special expertise weatherizing older buildings?

Your HDC may be able to refer you to contractors who have experience working with historic homes, and are familiar with some of the issues that arise in the weatherization of older structures. It is likely that these contractors will be able to help you to improve the overall energy efficiency of your building while keeping its valuable historic fabric intact and unharmed.

Am I allowed to replace my windows as part of my energy efficiency upgrade?

Historic windows have many parts that may require repair.



Most historic district commissions will advise you to not replace your windows. HDCs are concerned with the aesthetic appearance of buildings from the public viewshed, and the windows are often considered to be one of the most important character-defining features of the house.

It is important to note, however, that most energy efficiency experts will tell you to address your windows during the very last phase of a renovation.

Although windows are, by nature, one of the weakest points in a building envelope, window replacement is not usually a cost-effective option, because windows are expensive and the amount of energy saved by the new windows takes a very long time to pay back. Other solutions, like adding insulation to your attic, for example, are cheaper and faster, and will typically save more energy than changing out windows. Most of the time, these sorts of improvements should be performed before you think about upgrading windows.

The Nantucket Island HDC recently published district guidelines with useful information on window rehabilitation and replacement. Please see Appendix A.

With all of that said, many homeowners have already completed insulation retrofits and other efficiency renovations, and are ready to explore the option of getting new windows and doors. If you are at this point, choose your new windows carefully. Many of today's energy-efficient window options have a relatively short lifespan, partly due to the fact that they are not repairable, like historic wooden windows. If the window breaks, it is often necessary to buy a whole new one, after putting the broken one in a landfill.

In addition, the HDC may have strict requirements for window appearance and materials, and in some cases they may not allow window replacement at all. It is important to check in with your HDC early on in the process to learn as much as you can about what they encourage and discourage. Take note that historic windows contain a significant amount of embodied energy, and are often constructed from valuable old growth wood or other original materials; for this reason, the environmental life-cycle costs of replacing them can be quite high. Studies have shown that a combination of window repair, air sealing, and the addition of an appropriate storm window can achieve energy savings that are comparable to those gained by installing new windows.

If your HDC does allow window replacements, and you decide to move forward, we recommend that you donate the old windows to an architectural reclamation organization – recycle them, in other words, rather than throwing them away.

I've heard preservationists refer to the Secretary of the Interior's standards. What are they, and do they apply to my house?

The Secretary of the Interior's Standards for the Treatment of Historic Properties are a set of general guidelines that are intended to help people protect and preserve our nation's historic resources. These Standards form the basis for most local HDC guidelines. In addition, programs administered by the Secretary through the National Park Service are also required to use the Standards, as are recipients of grant money from the national Historic Preservation Fund. Ask your HDC about this for more information, and visit http://www.nps.gov/history/hps/tps/standguide/ to check them out.

Do you have information about energy efficiency principles that were originally applied to my home?

In many New England communities, the local Historic District Commission is a valuable informational resource. Often, commissioners are well-acquainted with town folklore and history, and they usually have access to records and documents that may contain interesting information about your historic home. Your community may also have a Preservation Society (or similar organization), and the HDC can usually connect you with their resources as well.

Depending upon your house's age and history and the record-keeping situation in your town, you may be able to dig up some interesting facts about its architectural past, including information about traditional energy efficiency measures that may have been applied by the original inhabitants. In some areas, a local building vernacular might include a subset of little tricks that are mostly unknown to modern residents. In Nantucket, for example, traditional wooden windows were weatherized by means of oak splines that expanded and contracted with changes in temperature.

These splines represent an early form of weather-stripping, and actually still act as air barriers when properly installed.

The HDC may also be able to help you plan efficiency solutions that are non-building related, such as the strategic use of deciduous vegetation to shade your home.

Am I allowed to install renewable energy systems on my home or in my yard?

Solar thermal installations sit flush with the roof.

It is a common misunderstanding that HDCs will automatically reject requests from residents who wish to use renewable energy systems on their historic property. In fact, many HDCs across New England have allowed residents to install various types of renewable technologies within historic districts. The process, however, depends on your community's Commission and the level of aesthetic regulation applied in your district. Some HDCs do not allow systems that can be seen by the public, and others have requirements regarding the appearance of the technology itself. For example, some HDCs will readily allow solar panels as long as they are in line with the plane of the roof, treated as architectural features, or colored to match roof shingles. Often, there may be tradeoffs in efficiency that come with meeting HDC requirements, and these should be thoroughly understood before you commit to a new system.

It is very important to consult with your HDC during the planning process – certainly before you purchase the upgraded system – in order to avoid potential legal problems. Also, remember that you should try to "eat your efficiency vegetables before your renewable desserts" – the smartest energy upgrade strategists advise you to improve your home's energy efficiency as much as possible before looking into renewables.

If you are interested in exploring possible renewable energy opportunities, be sure to do your research. Here is a quick primer introducing some of the types of systems you might want to research further, along with our comments regarding potential HDC restrictions.

The Nantucket Island HDC has published useful design guidelines for the installation of renewable energy within the island's historic district; these guidelines comprise Appendix A of this guide. Reviewing their guidelines may prepare you for the question your historic district commission may ask about your proposed installation.

Hot water heating:

Solar thermal hot water – solar thermal is one of the most cost-effective options for renewable energy generation in New England. Because the collectors are usually roof-mounted, you will need to consult your HDC.

Electricity:

Photovoltaic (solar) panels

Traditional, roof-mounted – depending upon your HDC, traditional roof-top panels may or may not be allowed. Some HDCs will approve roof-mounted panels that are treated as architectural features.

Roof-integrated – these panels might be more acceptable to your HDC, as they are built into the roof itself, and flush with the surface.

Ground-mounted – in cases where HDCs do not allow roof-top panels, ground-mounted PV might be an option. Of course, be sure that you site panels properly to achieve maximum efficiency.

Residential-scale wind – this might be an option for some residents, but only with extensive research. You need to be aware of HDC height restrictions (and local zoning restrictions), and you should have a thorough knowledge of the types of technologies available, as well as the wind patterns in your specific geographic location. It is essential to perform the necessary research before investing in a wind system, because wind power is not cost-effective in some areas.

Space heating:

Geothermal* – this may or may not be an appropriate solution for you, depending upon the geology of your area and how tightly you are able to insulate your home. Geothermal is most cost-effective when minimally sized, and is best installed after a significant energy efficiency retrofit. HDCs usually do not object to geothermal, because (most of the time) it can't be seen.

Biomass or biofuel – the HDC does not need to be consulted if you plan to use biomass or biofuel to heat your home, but you will need to make sure you have the correct equipment. Do your homework and check with a trustworthy home heating specialist, and be sure that you have access to a reliable supply of fuel. Because biofuels burn more cleanly than traditional number two fuel oil, the use of a biofuel-heating oil blend actually increases fuel efficiency in the furnace by 5 percent.

ENERGY EFFICIENCY CHECKLIST

And of course, you should also make sure to do all of these "little" things, which are cheap, fast, easy, and will not harm the historic value of your home, though they WILL save you money on your electricity and heating bills.

Electricity conservation and efficiency:

Employ electricity conservation strategies. Turn things off when you are not using them, and help other members of your family do the same.

Use power strips for things like phone chargers, instant-on appliances like TVs and office equipment. Some of these items draw energy even when they are turned off, and over the course of a year, these "ghost" or "phantom" loads add up to billions of dollars in energy expenditures for U.S. consumers. If you shut off the power strip when you are not using the device in question, the "ghost load" is eliminated.

Assess electricity usage with a watt-meter. Do your own mini-audit, and see which of your appliances uses the most energy. Check your local library to see if they have a household energy meter available for checkout. The more you understand about your household's electricity consumption, the easier it is to identify opportunities for savings.

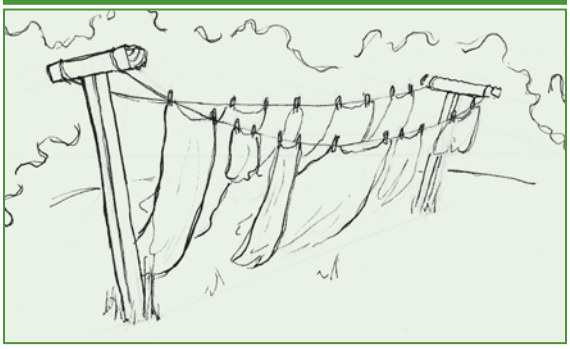
Research and purchase energy-efficient appliances. Look for the Energy Star rating. In many cases, the payback time for this solution is short and replacing an appliance can be done immediately. There are also tax credits or rebates available for homeowners making Energy Star purchases.

Use energy-saver settings on computers and office equipment. Screen savers do NOT save energy! Shut your computer off at night, and set the energy saver functions on your computer so that it "sleeps" when you are not using it.

* Geothermal energy is energy taken from the heat of the Earth's core – whether in the form of water heated in hot springs, as in the case in western states, or captured by burying pipes in the ground where there is a constant, more moderate temperature than the air. In the northeast, for instance, "ground source" geothermal systems rely on a temperature below ground, year round, of about 50 degrees F.

Dry your clothes on the line. If the weather permits, this one is easy. If you don't use the dryer, you're consuming less energy. You should check with the HDC to see if there are any local regulations or covenants prohibiting clotheslines and, if there are, try to get rid of them.

Drying clothes outside saves energy and money.



Change the light bulbs. Switch out the old incandescent for compact fluorescent lights (CFLs). They last longer and light your home more efficiently. You may have already done this, but if not – now is the time!

Thermal conservation and efficiency:

Change your thermostat settings, or change to a programmable thermostat. Just a few degrees lower in winter and higher in summer can save chunks of money on your energy bills. If you use a programmable thermostat, set it to use less energy when people are not home. If you have a regular one, be sure to turn it down (or up, if you're air conditioning) before leaving the house or going to bed.

Install weather-stripping. You can chat with your auditor or contractor about this one, but if you feel like getting a jump-start on the big renovation, a little weather-stripping around windows and doors can go a long way to seal up some of the more obvious cracks.

Storm windows. Adding storms is a non-invasive strategy for upping the energy efficiency of your existing windows. HDCs like them because they are reversible, and they are easier and more cost-effective than window replacement. Studies have suggested that a single-glazed, traditional window combined with a low-emissivity coated storm window has a similar U-value to a new double-paned window.

Clean your vents and filters regularly. This improves the efficiency of any heating system. Be sure to follow instructions and perform this routine maintenance safely.

U-Factor

The U-factor refers to the thermal transmittance of a material, often a window – in other words, it is a measure of heat loss. A lower U-factor means that the window will perform better during cold weather, reducing heat loss and minimizing moisture condensation. The U-factor is the reciprocal (or inverse) of R-value.

Low-e

Newer styles of energy efficient windows can be coated with a transparent layer of metal that is just a few molecules thick. This is called a low-emissivity, or low-e, coating, and it reduces heat flow through the window by slowing the rate at which heat is emitted from the glass.

Focus on THE PROCESS:

Thetford, VT: Thetford Center Community Center

Rebuilding windows in Thetford, VT.

The Thetford Center Community Center is housed in a former one-room schoolhouse listed on the Vermont State Register of Historic Places. With only marginal insulation in the attic, the building represented a significant energy expense for the community. The Thetford Energy Committee (TEC) decided to assess the savings that would result from adding dense-packed cellulose insulation to the walls of the Center. To provide partial funding for the renovation, the energy committee applied for and received a Vermont Community Climate Change Grant from the state. The TEC also partnered with Sustainable Energy Resource Group (SERG), a non-profit in Vermont that trains volunteers and identifies contractors to do technical work.

Before beginning the project, SERG set up a meeting with the Vermont Preservation Trust, a non-profit organization that provides preservation consulting services and grant money for historic building renovations. The Preservation Trust expressed concern that dense-packing the walls of the building with cellulose would almost certainly result in moisture issues, potentially causing structural damage to the building and peeling of exterior paint. SERG engaged building scientists in a discussion with the Preservation Trust to help them study the issue further. After consultation, the Trust decided to allow dense-packing of the walls with ongoing moisture monitoring.

The Preservation Trust also hired a historic window restoration consultant to do a study of the TCCC's window needs, and led a workshop for community volunteers on restoring and air sealing historic windows, using the TCCC windows as a model.

In addition to air sealing and insulation, SERG determined that the best solution for preserving the building would involve several steps, including the installation of drainage around the outside of the building to keep moisture out, the addition of a range hood to control moisture from the cook stove, provision of combustion air for the furnace to prevent back-drafting, and installation of a heat recovery ventilator to remove moisture from town meeting crowds and provide fresh air.

This story represents a good example of successful information gathering. The Thetford Energy Committee engaged in a consultation process that included energy professionals, preservationists, and community members, and this resulted in a more thorough understanding of options for the TCCC building.

Climate Change

Intergovernmental Panel on Climate Change
http://www.ipcc.ch/

Energy Efficiency and Sustainability

Carbon Coalition
http://www.carboncoalition.org/index.php

Connecticut Clean Energy Fund
http://www.ctcleanenergy.com/

Efficiency Maine
http://www.efficiencymaine.com/

Efficiency Vermont
http://www.efficiencyvermont.com/pages/

Maine Interfaith Power and Light
http://www.meipl.org/

NH Carbon Challenge
http://carbonchallenge.sr.unh.edu/index.jsp

Green Building

U.S. Environmental Protection Agency – Green Building
http://www.epa.gov/greenbuilding/

U.S. Green Building Council
http://www.usgbc.org/

New England Preservation Organizations

Connecticut Trust for Historic Preservation
http://www.cttrust.org/

Historic New England
http://www.historicnewengland.org/

Maine Preservation
www.mainepreservation.com

New Hampshire Preservation Alliance
www.nhpreservation.org/html/home.htm

Preservation Massachusetts
www.preservationmass.org

Preserve Rhode Island
http://www.preserveri.org/

Preservation Trust of Vermont
http://www.ptvermont.org/

National Preservation

National Trust for Historic Preservation
http://www.preservationnation.org/

http://www.preservationnation.org/issues/sustainability/

Secretary of the Interior's Standards
http://www.nps.gov/history/hps/tps/standguide/

Project Partners

Clean Air-Cool Planet
http://www.cleanair-coolplanet.org/

NH Division of Historical Resources
www.nh.gov/nhdhr

Strawbery Banke Museum
http://www.strawberybanke.org/

Sustainable Nantucket
http://www.sustainablenantucket.org/

State Historic Preservation Offices (SHPOs)

Connecticut Historical Commission
No web page; call (860) 566-3005

Maine Historic Preservation Commission
http://www.state.me.us/mhpc/

Massachusetts Historical Commission
http://www.sec.state.ma.us/MHC/

New Hampshire Division of Historical Resources
www.nh.gov/nhdhr/

Rhode Island Historical Preservation and Heritage Commission
http://www.preservation.ri.gov/

Vermont Division for Historic Preservation
http://www.historicvermont.org/general/reviewfaq.html

Sustainable Development

Congress for the New Urbanism
http://www.cnu.org/

Smart Growth Online
http://www.smartgrowth.org/

SUSTAINABLE PRESERVATION
AN ADDENDUM TO *BUILDING WITH NANTUCKET IN MIND*

Acknowledgments

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INTRODUCTION

The primary intent of this document is to provide assistance to Nantucket's building owners and construction professionals who wish to incorporate the concepts and practices of sustainability into their structures, while maintaining the historic integrity of the individual buildings, and through them, the overall character of the island. With the help of these guidelines, the concepts of minimal intervention, reversibility, and conservation* can be incorporated into all work on Nantucket. This, in turn, will help ensure the island maintains the sense of place enjoyed by locals and tourists alike while still achieving the goal of energy efficiency.

Context

Through the efforts of local nonprofit, Sustainable Nantucket, in 2008 the Town of Nantucket joined the International Council of Local Environmental Initiatives (ICLEI) Cities for Climate Protection (CCP) Campaign. As part of this Campaign, a rough draft of a Climate Protection Action Plan for the Town of Nantucket was recently completed by Carrie Petrik, a Clear Air-Cool Planet Climate Fellow working for Sustainable Nantucket. A key objective of this Plan is to reduce Nantucket's carbon footprint** by approximately 22 percent by 2020. This goal can only be achieved if every possible action is taken, including making the island's nearly 13,000 buildings more energy efficient.

During a Carbon Emissions Inventory of the island performed by Sustainable Nantucket in 2008, it was found that roughly 30 percent of the local carbon emissions can be attributed to day-to-day building operations.[i] Because of Nantucket's well-preserved heritage and its citizen's growing interest in energy efficiency, it is necessary to examine the relationship between sustainability and preservation. Consequently, this set of guidelines has been written to help clarify some of the more complicated issues unique to historic areas.

Inherent Energy Efficiency

Close examination of Nantucket's traditional buildings reveals the potential for employing a number of techniques for achieving energy efficiency that are often forgotten today. For example, many buildings were designed around one or more masonry chimneys, responding to the need to keep buildings warm during the winter months. Another technique was the use of low ceilings with smaller rooms separated by interior walls and doors. This interior layout allowed a single fire to heat the necessary rooms while leaving the unused rooms colder.

The siting of buildings and their fenestration*** was also an early design choice, made in response to Nantucket's environment. Traditionally, southern walls have more windows and the openings are typically larger, in order to take better advantage of the solar-heat gain available during the cooler months. Conversely, a building's northern walls typically had the least amount of glass (and sometimes wall area) due to the harsh winter winds. Operable windows, specifically double hung windows, were used for passive cooling**** as were shutters and interior drapes. Appropriately placed landscaping was also employed for windbreaks and shading. These traditional techniques can and should be rediscovered and utilized in order to reduce the energy and fuel demands of mechanical heating and cooling equipment.

* **Minimum intervention** is the principle that the less change or alteration done to a historic resource the more integrity that resource retains. **Reversibility** is the principle that nothing should be done to a historic resource that can cannot be undone or reversed without permanent damage to the resource. **Conservation is** the careful utilization of a natural resource in order to prevent depletion.

** **Carbon Footprint** is the total set of GHG (greenhouse gas) emissions caused directly and indirectly by an individual, organization, event or product.

*** **Fenestration** is the arrangement and design of windows in a building.

**** **Passive cooling** refers technologies or design features used to cool buildings without power consumption.

Embodied Energy

A frequently overlooked aspect of energy in existing buildings is their embodied energy. Embodied energy is the energy required to extract the raw materials, and manufacture, transport, and install a building product.[ii] An existing building represents all of the fossil fuel needed to construct the building originally – energy that is wasted when a functional building is demolished. In a recent study conducted in the United Kingdom, it was determined that an energy-efficient new home would take between 35 and 50 years to recover the energy expended in constructing it.[iii] Of course, embodied energy is not simply limited to exterior materials, and must also be considered when dealing with the interior fabric of existing buildings, especially those with historic value. Recognizing a building's existing material as valuable is the first and most significant step towards becoming energy efficient.

Energy Efficiency in Historic Buildings

These conservation measures include a broad spectrum of methods, ranging from low-cost and easy solutions like light-bulb replacement, to more extensive solutions such as upgrading appliances and mechanical equipment. Simply reducing the constant need for electricity through conservation, for example, may allow a building owner to install smaller amounts of renewable energy equipment.

Reversibility is the principle that nothing should be done to the historic fabric of a structure that cannot be undone or reversed without permanent damage to said historic resource.

It is recommended that building owners start exploring the many options for reducing energy consumption at the U.S. Department of Energy's Energy Efficiency and Renewable Energy website listed in the links below. However, building owners must keep in mind that some of these tips may not be appropriate for historic buildings. Those interested in integrating sustainable technologies into their structures should always consider the historic integrity of the building before applying some of the more invasive techniques, such as window replacement or insulation. Nantucket's building owners can find sustainability tips that are specifically geared towards historic structures at the website of the National Trust for Historic Preservation, also listed below.

Minimal intervention is the principle that states that the less change or alteration done to a historic resource, the greater the integrity that resource retains. It is used nationally to promote responsible preservation practices.

While not all energy efficient techniques can be used on historic structures, there are a number of important concepts regarding both sustainability and preservation that building owners and building professionals must consider. Minimal intervention and reversibility, as well as conservation, mentioned previously, are all important concepts in achieving the ultimate goals of both preservation and sustainability.[iv] Minimal intervention often surfaces when discussing the preservation of historic buildings. The benefit of utilizing the principles of minimum intervention through the retention of existing (particularly character defining*) fabric is in the reduction of construction debris, the retention of embodied energy, and the preservation of historic building features. Another concept which shares similar benefits, and is often mentioned with regard to historic structures, is that of reversibility. It is especially important to utilize these principles when creating your renewable energy infrastructure. There also are a number of renewable energy production techniques that, once installed, have little or no visual impact on the property where they are employed. Interested applicants are encouraged to consider all of the available options before deciding on any particular course of action.

* **Character-defining features** include the overall shape of the building, its materials, craftsmanship, decorative details, interior spaces and features, as well as the various aspects of its site and environment.

It is the intention that these guidelines be updated periodically in order to better reflect advances in sustainable technologies or methods as the need arises, and that the guidelines in no way hinder an applicant from presenting new and creative solutions for discussion. It therefore remains the building owners' responsibility to think creatively about their needs and to use the HDC and its staff as a resource in helping Nantucket become more energy efficient.

Important Energy Conservation Links

Department of Energy: www.energysavers.gov

National Trust for Historic Preservation: http://www.preservationnation.org/issues/sustainability/

WINDOWS AND DOORS

Introduction

The Nantucket Historic District Commission (HDC) encourages the protection and restoration of historic wood windows for all Nantucket buildings. The restoration of existing windows is important because the retention of this fabric helps to preserve an irreplaceable cultural resource, and because restoration is an environmentally responsible alternative to replacement. It is crucial to note that when historic doors and windows have been properly sealed against air infiltration* and augmented with storm-windows, they meet a number of important sustainability goals, including the reduction of waste, reuse of existing materials, and increased energy efficiency. While homeowners often are convinced that replacement windows may solve their energy and renovation problems, this section will outline other cost effective steps which will increase the efficiency of older windows while also maintaining historic integrity.

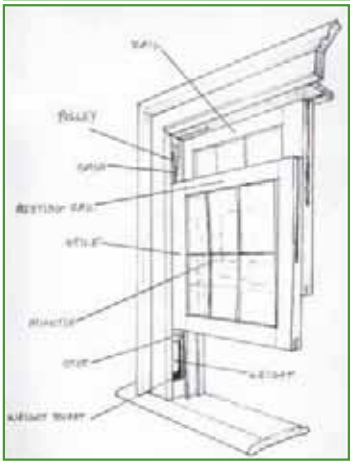
Figure 1. Wood Screens

It also should be noted that heat loss through windows is not a problem unique to historic buildings; windows in new construction often have the same issues due to poor installation or function of the windows. Reducing air infiltration should be the first priority of any preservation-retrofitting plan.

Repair, Don't Replace

Preserving a building's existing windows not only conserves their embodied energy** , but also eliminates the need to expend more energy extracting, manufacturing, transporting, and installing the replacement window. Typically made of superior old-growth wood, traditional windows can be restored, even with deferred maintenance. The restoration of these existing wood windows will help reduce landfill waste, approximately 40 percent of which is composed of construction debris.[v]

Figure 2. Double-hung window



In the building industry "replacement window" can mean two distinct things. One is the replacement of the sash of a window, leaving the frame and sill. The other refers to the replacement of an entire window including the frame and

* **Air infiltration** is the uncontrolled inward leakage of outdoor air through cracks, interstices, and other unintentional openings of a building, caused by the pressure effects of the wind and/or stack effect.

** **Embodied energy** – The energy required to extract the raw materials, manufacture, transport, and install a building product.

sash. On Nantucket, if an original window has degraded beyond repair or if it is determined that a new window is needed, it is recommended that wood replacement sashes be used. In general the HDC prefers the use of wood replacement sashes or windows. This is because vinyl and aluminum-clad windows are aesthetically inappropriate within the Old Historic District, Siasconset Old Historic District and on contributing structures. Vinyl and aluminum windows are more energy intensive to produce, have a shorter expected life-span than wood windows, and may degrade or corrode in Nantucket's climate.[vi]

Windows & Sustainability in Historic Design

In many ways, historic structures are inherently sustainable, whether through their use or their original design. Due to Nantucket's variable weather and environment, buildings here traditionally have an overall window area that makes up less than 20 percent of the overall wall area.[vii] Windows typically are moderate in size and tend to be more prominent on the south-facing wall. South-facing windows maximize solar-heat gain in the winter and can be opened to promote air circulation in the summer. This traditional fenestration balances both the heat loss in winter and the need for light and cooling in the summer.

Non-invasive Techniques

Many energy efficiency techniques recommended to historic building owners do not require any alteration to historic buildings. Some of these techniques include: the use of operable window shutters and awnings (when historically accurate for the structure); interior hangings and curtains to help insulate in the winter and stop radiant heat gain in the summer; and the deliberate use of landscaping to block the wind in the winter and provide shade to the building in the summer. These simple techniques will reduce energy consumption through a decreased need for heating and air-conditioning.

Storm Windows

A storm window is a supplementary window sash that adds a layer of glass to an existing window. Storm windows are the least invasive and most appropriate way to increase the energy efficiency of historic windows. All storm windows enclose a thermal air space that approximately cuts heat loss in half.[viii] Exterior storm windows also protect historic windows from the elements, prolonging the life of windows while lowering maintenance costs.[ix] A single-glazed, traditional window combined with a "low-emissivity"* coated storm window can have a similar "U-value"** as a new, double-paned window.[x] However, proper installation of storm windows is an important factor when assessing their performance. Owners of contributing historic structures should consult with the HDC staff when choosing storm windows in order to determine the most energy efficient combination that is appropriate for the building.

Figure 3.
Exterior Storm window

For exterior applications, the use of wooden storm windows is recommended. These not only are more historically accurate than metal storm windows, but they also require less energy to produce and can endure longer than some metal storm windows in Nantucket's climate. In some instances, the use of metal storms may be acceptable as long as they do not obscure window details. Single-track metal storms that fit within the window trim tend to have less visual impact and are more durable than triple-track storm

* **Low-emissivity coatings** reduce heat flow by slowing the rate at which heat is emitted from the glass.

** **U-Value** or Thermal transmittance (Btu/hr-ft-°F) is the rate of heat flow per unit time per unit area per degree temperature differential. Essentially a measure of thermal transmission through window materials and the boundary air films. U-value is the inverse of R-value.

windows. The use of singe-track metal storm windows is preferred over the replacement of, or installation of, triple-track storm windows. Again the building owner will want to consult the HDC staff before making any final decisions.

Storm Doors

Storm doors come in a variety of styles. Like storm windows, storm doors create an intermediate thermal layer of air. Wood storm doors are preferable and must match the design of the building. Storm doors decrease air infiltration around the door opening, and are especially useful when the door has windows that may be difficult to weatherize in any other way.

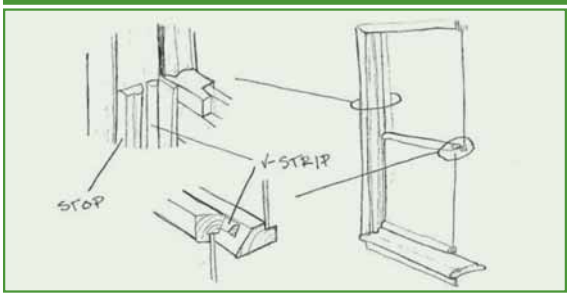
Figure 4. Exterior storm door

Weatherization

Windows

There are many non-invasive techniques that can be used to weatherize existing windows, including the passive techniques mentioned earlier. Nantucket already has a number of established weatherization practices that may be preferable to most current, modern techniques. One such technique is the proper utilization of sash locks, when appropriate. A lock that closes properly forces the opposing parts of a window together preventing air infiltration. The HDC staff may be able to assist building owners and contractors in utilizing non-invasive and traditional techniques.

Figure 5. Window weather stripping



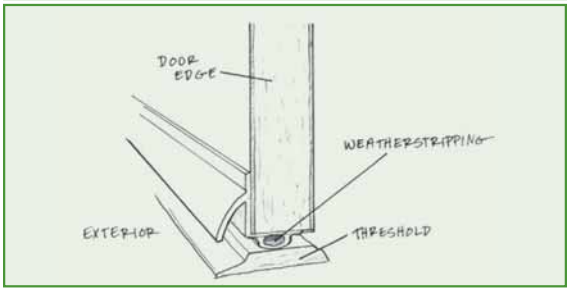
Where drafts occur in and around a window, a building owner may wish to consider weather-stripping.* This easy, and typically reversible, form of weatherization can be used to help eliminate air infiltration. Each window style requires a slightly different weather-stripping technique. If the building is considered contributing, an owner may wish to consult the HDC staff for more detailed information about appropriate weather-stripping. Typically, the areas most prone to air infiltration, especially in a double hung windows, are where the sash and the jamb meet, and at the meeting rails. The insertion of seasonal weather-stripping** can help to limit these drafts. In double hung windows that have a weight and pulley system the weight pocket can be another source of air infiltration. The two most effective ways to seal this area are either plugging the opening with a piece of solid foam or purchasing a plastic cover for the pulley specifically designed to minimize the opening while allowing the mechanism to work. The Department of Energy has a number of additional weather-stripping suggestions that can be found on their website.[xi]

* **Weatherstripping** is a narrow strip of metal, wood, rubber, or the like placed between a door or window sash and its frame to exclude rain, wind, etc.

** **Seasonal weatherstripping** refers to weatherstirpping that is removed during the warmer months. It can be made of a number of materials, most typically felt, neoprene, or foam.

Doors

Figure 6. Exterior Door weather stripping



With doors, as with windows, it is important to determine if there is an existing, historic form of weatherization before employing modern solutions. If it is determined appropriate, the basic weather-stripping around exterior doors will create a tighter fit between the door and its frame, reducing air infiltration by as much as 20 percent. [xii] Those techniques that have minimal impact on the exterior of the door are preferred. Therefore weather-stripping between the door and the jamb is recommended, as is an interior door sweep.

New Construction

Traditional fenestration is encouraged for all buildings on the island. The use of double-paned windows is encouraged on non-contributing buildings outside the old historic districts. True divided light wood windows are preferred in all new construction. Single-glazed true-divided light windows are generally approved on buildings within the old historic districts and on contributing buildings. Any new window should be installed with proper weatherization techniques.

WINDOWS AND DOORS GUIDELINES

Inside the Historic Districts and Contributing Structures

Existing Buildings:

- Historic windows should be preserved and restored, taking advantage of the embodied energy represented in the existing material.
- Wood storm windows and doors are encouraged.
- Sash locks should be repaired or installed.
- If traditional weather-stripping exists it should be replaced in kind. If it does not then weather-stripping may be installed where needed.
- Passive energy saving measures such as shutters and awnings (when historically appropriate), as well as the use of curtains, are highly encouraged.

New construction and additions:

- Traditional fenestration proportions (approximately 25 percent of overall wall area) should be considered in the design stages.
- Single-paned wooden windows are required and should be properly weatherized during installation.
- Storm windows and doors are encouraged.
- While wood storm windows are encouraged metal storm windows are acceptable on secondary facades if they are not visible from the publicly traveled way.
- Passive energy saving measures such as shutters and curtains are highly encouraged.
- Window and doorframes may be caulked on the interior. Care should be taken to choose a caulk that is chemically compatible with interior surfaces.

Outside the Historic Districts (if not a contributing structure)

Existing Buildings:

- Wooden true divided-light (those with true muntins) are preferred. Vinyl or aluminum windows are discouraged.
- Windows and doors should be retrofitted with appropriate weather-stripping where needed.
- Storm windows and doors should be installed. Wood storm windows and doors are preferable but metal options may be acceptable.

New construction and additions:

- Traditional fenestration proportions (approximately 20 percent of overall wall area) should be considered in the design stages.
- Double- and triple-paned windows are encouraged. Wooden true divided-light (those with true muntins) are preferred. Wood windows with applied muntins may be considered but vinyl or aluminum windows are discouraged.
- Windows and doors should be installed using appropriate weatherization techniques including weather-stripping and caulking.
- Storm doors should be installed. Wood storm doors are preferable but metal may be acceptable.

SOLAR TECHNOLOGIES

Photovoltaic Systems

At the time of publication of this addendum, there are only two prevailing types of photovoltaic (PV) collectors: photovoltaic panels and building integrated photovoltaics (BIPV). Both systems exist to convert the sun's energy into electricity. BIPV can be considered because it typically makes less of a visual impact on a structure. Unfortunately, this technology is currently not as efficient as photovoltaic panels. The following guidelines should therefore be applied to any style of PV system that has been deemed appropriate according to each building owner's unique circumstances, keeping in mind that it is always preferable to use the least visible technology.

Solar Thermal Systems

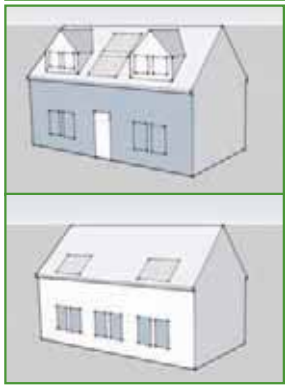
Solar Thermal refers to any system that harnesses the power of the sun to heat a liquid medium for specific applications such as domestic hot water, space heating, and pool heating. As of the publication of this addendum, there are a number of different technologies that are designed to help lower energy bills by utilizing solar thermal systems. Some technologies are available that allow collectors to be hidden entirely within the roof structure, and should be considered (especially for new construction) because of their minimal visibility. However, this guideline will primarily focus on technologies incorporating collectors (whether evacuated tubes or panels) that require direct sunlight.

Figure 7. Photovoltaic Ground Array

Placement & Design of Photovoltaic and Solar Thermal Systems

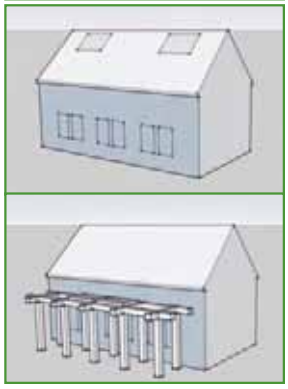
The utilization of "energy producing" technologies, such as photovoltaics and solar thermal, should only be considered after every effort to reduce a structure's energy consumption have been made. It is appropriate to consider placement of PV or solar thermal arrays elsewhere on the property before considering mounting this technology onto the primary structure. This is especially important in Nantucket's Old Historic District, in Siasconset's Old Historic District, on contributing buildings or in historically important landscapes, where the use of this technology may have a higher degree of visual impact.

Figure 8. Not Recommended



When determining where to place PV or solar thermal collectors, it is important to attempt to minimize any adverse effects upon a structure's existing fabric, as well as to mitigate the visual impact these panels and all of their supplementary equipment may have upon the surrounding area. As eventual wearing out of parts is expected with these technologies, it is important to note that equipment must be replaced with like kind. The HDC will consider any replacement that is not exactly like the original to be a change in design, which requires a new application of appropriateness.[xiii]

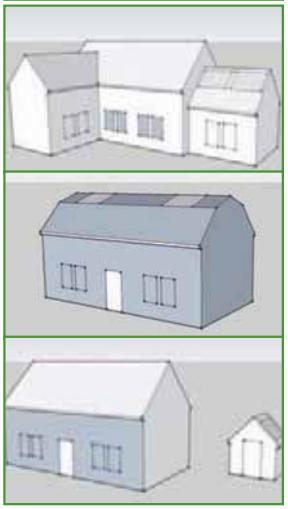
Figure 9. Recommended



When beginning an investigation regarding where best to incorporate PV or solar thermal collectors onto a property, the owner of any structure should always fully consider the principles of minimum intervention and reversibility. The entire site must be fully examined for its potential to accommodate these technologies effectively. The most preferable placements for these technologies will have no physical impact on the primary structure and have negligible visual impact upon the site as a whole. Therefore whenever possible, the least visible installation of ground arrays is preferred. If it is necessary for an array to be placed on a structure, it is encouraged that the array to be placed somewhere other than on the primary structure. For example, placement on any non-contributing ancillary structures (such as detached garages or sheds) would stand a greater chance of approval than an installation proposed only on the primary building.* The creative placement of PV and solar thermal collectors may be encouraged, if such placement limits any adverse impact of the array (e.g. in an existing skylight).

Because the sloped roofs typical of Nantucket's built environment are such a character-defining feature of the island's cultural heritage, roof-top equipment installations should be carefully designed and positioned. The basic elements of design to consider are: balance, proportion, color, rhythm, and scale. Additionally, PV and solar thermal collectors should be kept on the same plane as the roof, with the color of the panels in keeping with the surrounding roofing materials.

Figure 10. Recommended



* A **non-contributing structure** is defined as a building that is not an intrusion but which does not add to a historic district's sense of time, place and historic development.

PHOTOVOLTAIC AND SOLAR THERMAL GUIDELINES

Applications for photovoltaic and solar thermal systems in the Old Historic District, Siasconset Old Historic District, and those on contributing properties are likely to attract a higher level of scrutiny. This also is true for installations on contributing buildings, and where lack of vegetation makes an installation visible from surrounding areas.

Existing Buildings and New Construction:

- The least visible application of technologies and their supplementary equipment is recommended. If the array is located on the ground, appropriate screening may be necessary.
- Applications of these systems as a ground array or on non-contributing ancillary structures (as opposed to on the primary structure) are encouraged.
- The appropriateness of a photovoltaic or solar thermal system will be based upon the historic character and architectural significance of the individual structure and its relation to its surroundings.
- Photovoltaic and solar thermal installations need to be designed carefully and positioned to be in scale with the structure's roofline, while maintaining a balance, scale, proportion, and rhythm with other features of that elevation.
- Systems should be on the same plane as the roof with the color of the panels in keeping with the surrounding roofing materials.

Recommended Application Materials:

Applications for renewable energy systems should include materials adequate to describe the proposed equipment, the structure, and the surrounding area. These may often include:

- A sample of the product and supporting documentation if available.
- Photographs of the installation site and surrounding area.
- A scaled drawing of the proposed system including all supplementary equipment.
- If the system is being proposed on the primary structure, the applicant should be prepared to discuss why placements with less visibility or less impact were not used.

WIND ENERGY CONVERSION SYSTEMS

Introduction

Wind Energy Conversion Systems (WECS) share a link with traditional windmills. Consequently there exists an historical precedent for their use on Nantucket. As it pertains to this addendum, wind energy conversion systems are devices that convert kinetic wind energy into rotational energy to drive an electric generator.[xiv] WECS designs currently range from tower-mounted applications (both horizontal-axis and vertical-axis) to a wide range of building-mounted designs. At the start of any homeowner's investigation regarding where to best introduce WECS technology onto a property, the principles of minimum intervention and reversibility should always be fully considered.

Tower-Mounted

In order for a wind energy conversion system to be fully effective, they are often required to be considerably taller than the surrounding landscape. This high rate of visibility is a possible hindrance to the application of these technologies on Nantucket. When determining the most appropriate placement for this technology, it is crucial to take into account the view of the turbine from all publicly traveled ways

Figure 11. Vertical WECS

its presence may affect. As a part of the review process, the adverse impact that the entire assembly could have upon the surrounding neighborhood may be considered. Those installations that have a lower degree of visual impact on or from the Old Historic Districts and contributing properties may be viewed more favorably.

In order to minimize the visual impact of both the tower and turbine, the color of the assembly should be muted and without visible graphics. Ancillary structures, when required, should also be included in the application for review; both suitably designed and appropriately screened when necessary. In the event a wind turbine is abandoned, or fails to produce electricity for one year, the Nantucket building inspector may require the removal of the device.[xv]

Building-Mounted

At the time of this writing, building-mounted WECS are not likely to be approved in locations that have an adverse impact on historic structures. This includes but is not limited to application on contributing structures or in the Old Historic Districts. In order to be most appropriate a building-mounted WECS should be mounted in the position where they have the least visual impact on the surrounding neighborhood. One might consider placement of these turbines on non-contributing ancillary structures and masses in order to limit adverse impact on the primary building. The placement of the turbines on any structure should consider all significant, existing, architectural features.

WIND ENERGY CONVERSION SYSTEMS GUIDELINES

When determining the most appropriate placement for a wind energy conversion system, either building or tower-mounted, it is important to consider its impact on the surrounding neighborhood, especially those with historic significance.

Tower mounted:

- The potential impact of the turbine on the applicant's property as well as its potential impact on surrounding neighborhood, including existing views, may be considered.
- The installation location having the least impact on the surrounding neighborhoods should be considered first.
- Ancillary structures, when required, should be included in the application for review and should be both suitably designed and appropriately screened, when necessary.
- The color of the turbine and tower should be muted.
- No graphics on the turbine or tower should be visible.

Figure 12. Vertical WECS and photovoltaic array

Building Mounted:

- Placement of building mounted WECS should take into account the existing architectural features of the structure.
- The placement with minimal visible impact may be considered more favorably.
- Placement on non-contributing ancillary structures, as opposed to primary structures, may be viewed more favorably.

ALTERNATIVE MATERIALS

As it pertains to these guidelines, the phrase alternative materials refers to any "green" or "sustainable" material that is intended as a substitute for traditional building materials. At this time alternative materials are not likely to be considered for use inside the Old Historic District, Siasconset Old Historic District, or on contributing buildings. However, building owners are encouraged to use sustainably harvested lumber or reclaimed materials whenever possible. The HDC may only consider alternative materials utilized to replace wood detailing and roofing on new construction outside the Old Historic Districts.

These alternative materials should resemble traditional materials and should in no way be visually distracting. Appropriate alternative materials for milled lumber, such as composite or engineered lumber, must be a solid composite material consisting of wood fibers. To be deemed appropriate, composite or engineered lumber must be millable* and weather in a way that is similar to traditional lumber.

The HDC also may consider alternative roofing materials, however they must be fire-resistant shingles of rectangular design and limited to uniform tones of black, dark green, or gray of a value no lighter than typical weathered shingles elsewhere on Nantucket.[xvi]

* **Millable** or able to be shaped onsite.

ALTERNATIVE MATERIAL GUIDELINES

Trim and Miscellaneous Details:

- Trim or detail elements made of alternative materials must be painted.
- Material must weather similarly to traditional lumber.
- Material must be millable.
- Alternative materials are inappropriate inside the Old Historic District or Siasconset Old Historic District as well as on contributing buildings.

Exterior Wall Surfaces:

White cedar shingles with a 5-inch exposure, and wooden clapboard with a 3 1/2-inch exposure are still the most appropriate wall surfaces. Building owners may want to investigate the use of wood that has been certified by the Forest Stewardship Council (FSC).[xvii]

RAIN BARRELS

Rain barrels are above-ground water storage systems that connect to gutter downspouts. In urban settings they are more often used as a source of fresh water for landscaping. The relationship between water and energy is not well publicized, however nationally approximately 3 percent of the nation's electricity is used to sanitize water.[xviii] Although Nantucket currently has a plentiful supply of fresh water, the Town's energy use can be greatly reduced if homeowners utilize captured rainwater in instances where potable water** is not requied.

Figure 13. Wooden rain barrel

** **Potable water** is water which is fit for consumption by humans and animals.

Currently barrels can be made of a variety of materials including wood and plastic. The HDC considers wood, as traditional material, more appropriate in general on Nantucket. In order to minimize the visual impact of rain barrels they should be placed on the rear of a building and, if necessary, be appropriately screened.

RAIN BARREL GUIDELINES

- Rain barrels should not be visibly intrusive.
- Wooden barrels are preferred.
- If the rain barrel is visible from the traveled way it may need to be appropriately screened.

PERMEABLE PAVERS

Permeable pavers typically are used as a less energy-intensive alternative to asphalt or concrete. Traditional styles of permeable pavers can be found throughout the island and include cobblestones, brick, gravel, and shell. While there are a number of modern pavers that serve the same function, the applicant should consider traditional solutions first. However, some modern permeable pavers are designed to promote the growth of vegetation. The HDC recommends this style where non-traditional options are appropriate.

Figure 14. Permeable Paving

GLOSSARY

Air infiltration - Uncontrolled inward leakage of outdoor air through cracks, interstices, and other unintentional openings of a building, caused by the pressure effects of the wind and/or the movement of air through chimneys, flue gas stacks, or other containers driven by the difference in air temperature.

Carbon emissions - Polluting carbon substances released into atmosphere.

Carbon Footprint - The total set of GHG (greenhouse gas) emissions caused directly and indirectly by an individual, organization, event or product.

Character-defining features - Include the overall shape of the building, its materials, craftsmanship, decorative details, interior spaces and features, as well as the various aspects of its site and environment.

Contributing structure -A structure judged to add to the historic district's sense of time, place and historic development.

Conservation - The careful utilization of a natural resource in order to prevent depletion.

Embodied energy - The energy required to extract the raw materials, manufacture, transport, and install a building product.

Fabric - The basic elements making up a building.

Fenestration - The arrangement and design of windows in a building.

Low-emissivitycoatings - Coatings that reduce heat flow by slowing the rate at which heat is emitted from the glass.

Millable- Able to be shaped onsite.

Minimum intervention - The principle that the less change or alteration done to a historic resource the more integrity that resource retains.

Non-contributing structure - A building which is not an intrusion but does not add to a historic district's sense of time, place and historic development.

Passive cooling -Technologies or design features used to cool buildings without power consumption.

Potable water - Water which is fit for consumption by humans and animals.

Reversibility - The principle that nothing should be done to a historic resource that cannot be undone or reversed without permanent damage to the resource.

Significant Structure - Any building on the island 50 years old or older which is either: 1) associated with one or more historic figures or events, or with a broad island architectural, cultural, political, economic or social history; or 2) is historically or architecturally significant whether by itself or in context with other buildings, in terms of period, style, method of building construction, or association with a noted architect or builder.

U-Valueor Thermal transmittance (Btu/hr-ft-°F) - The rate of heat flow per unit time per unit area per degree temperature differential. Essentially a measure of thermal transmission through window materials and the boundary air films. U-value is the inverse of R-value.

Weatherization - To make (a house or other building) secure against cold or stormy weather, as by adding insulation, siding, and storm windows.

Weather-stripping - a narrow strip of metal, wood, rubber, or the like placed between a door or window sash and its frame to exclude rain, wind, etc.

END NOTES

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