

Burlington Design Advisory Board

645 Pine Street
Burlington, VT 05401
www.burlingtonvt.gov/DPI/DAB
Phone: (802) 865-7188

Matthew Bushey
Ron Wanamaker
Karyn Norwood
Emily Morse
Vacant
Jay White, Alt.
Kathleen Ryan, Alt.



DESIGN ADVISORY BOARD Tuesday August 24, 2021 3:00 PM

Physical location: 645 Pine Street, Front Conference Room, Burlington VT 05401

and

Zoom: <https://us02web.zoom.us/j/88190235586?pwd=RTBuN05KU2Z5SHN3Uk5yN2ZPVtI4QT09>

Password: 032878

Webinar ID: 881 9023 5586

Telephone: +1 929 205 6099 or +1 301 715 8592 or +1 312 626 6799 or +1 669 900 6833 or +1 253 215 8782 or +1 346 248 7799

Agenda

Session I – 3:00 PM – 3:30 PM

Historic Preservation Review Committee

Final Review of Historic Preservation / Energy Efficiency document, prepared in partnership with Burlington Electric under grant funding 07110-VT-20-10004 (2020.)

The programs and services of the City of Burlington are accessible to people with disabilities. Individuals who require special arrangements to participate are encouraged to contact the Department of Permitting & Inspections at least 72 hours in advance so that proper accommodations can be arranged. For information call 865-7188.

Non-Discrimination

The City of Burlington will not tolerate unlawful harassment or discrimination on the basis of political or religious affiliation, race, color, national origin, place of birth, ancestry, age, sex, sexual orientation, gender identity, marital status, veteran status, disability, HIV positive status, crime victim status or genetic information. The City is also committed to providing proper access to services, facilities, and employment opportunities. For accessibility information or alternative formats, please contact Human Resources Department at (802) 540-2505.



CITY OF BURLINGTON **HISTORIC BUILDINGS'** PATH TO NET ZERO ENERGY

A GUIDE FOR BUILDING AND HOMEOWNERS

ACKNOWLEDGMENTS

THIS GUIDE WAS DEVELOPED IN PARTNERSHIP WITH



SPECIAL THANKS

Jennifer Green

Director of Sustainability & Workforce Development | Burlington Electric Department

Katie Dorey

Sr. Innovation Projects & Customer Care Specialist | Burlington Electric Department

Mary O'Neil

Principal Planner for Development Review | City of Burlington

Abigail Ahern

Sustainability Consultant | City of Burlington

Jenna Antonino DiMare

Executive Director, Vermont Green Building Network | Director, Burlington 2030 District

Advisory Committee

Rebecca Grannis, Jesse Beck, Heather Clark,
Thomas Visser, Chris Burns, Bob Bolin,
Brian Reilly, Catherine Lange

Cx Associates

Eveline Killian, Lauren Hagen

This publication has been financed in part with Federal funds from the Certified Local Government Program, National Park Service, U.S. Department of the Interior. However, the contents and opinions do not necessarily reflect the views or policies of the Department of the Interior, nor does the mention of trade names or commercial products constitute endorsement or recommendation by the Department of the Interior.

This program receives Federal financial assistance for identification and protection of historic properties. Under Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, and the Age Discrimination Act of 1975, as amended, the U.S. Department of the Interior prohibits discrimination on the basis of race, color, national origin, disability, or age in its federally assisted programs. If you believe you have been discriminated against in any program, activity, or facility as described above, or if you desire further information, please write to: Office of Equal Opportunity National Park Service 1849 C Street, N.W. Washington, D.C. 20240.

CONTENTS

01

WHY THE GUIDE?

02

HOW TO USE THE GUIDE

03

BENEFITS OF AN ENERGY RETROFIT

04

SO, YOU WANT TO RETROFIT YOUR BUILDING...

A1

APPENDIX

Planning a Retrofit
Strategies for your Retrofit
Additional Resources

WHY THE GUIDE?

Burlington, Vermont is a city with a unique history reflected in its buildings and homes. The architectural and visual character of Burlington depends on the sustainability of its historic buildings and homes, and the City is committed to ensuring their longevity.

Energy efficiency will provide long term benefits to both the Burlington historic buildings and their owners in reduced energy consumption, improved thermal comfort, and increased health of the buildings and occupants all while reducing our carbon emissions.

In addition, the City of Burlington is committed to upholding its ambitious climate goal of [Net Zero Energy \(NZE\) by 2030](#), established in 2019. To reach this goal, much of Burlington's existing housing stock will require energy efficiency and electrification measures.

To support these efforts, this guide was developed as a resource for historic building and homeowners to foster understanding of the processes, strategies, and benefits involved in the pursuit of the path to NZE.





HOW TO USE THE GUIDE

The information in this guide introduces opportunities that exist for City of Burlington historic buildings, and ways that homeowners can work to increase the energy efficiency of their property and begin on the path to NZE. The following pages are meant to offer a comprehensive overview of the processes, strategies, and benefits involved, while the appendix expands on these topics for those interested in a more detailed explanation.

KEY TERMS

Net Zero Energy (NZE)

Reducing and eventually eliminating fossil fuels. Burlington currently sources all its electricity from renewable resources, but heating and ground transportation still need to be addressed to meet this City-wide goal.

Energy Retrofit

Retrofit/retrofitting as we'll use it in this context refers to the modification or addition of equipment or systems to improve energy efficiency and reduce carbon emissions in existing historic homes or buildings.

QUESTIONS?

If you have additional questions, please reach out to the Burlington Electric Department's Energy Efficiency team!

efficiency@burlingtonelectric.com

BENEFITS OF AN ENERGY RETROFIT

Success in reducing carbon emissions from the built environment will require improving energy efficiency, beneficial electrification of heating and cooling systems, and increasing renewable energy sources. Retrofitting Burlington's existing housing stock to become Net Zero is a huge opportunity for reducing community-wide emissions. It may also result in the following positive outcomes:

- Reducing energy costs for owners
- Improving thermal comfort
- Quieter systems
- Improving indoor air quality
- Reducing structural degradation due to mold
- Maximizing the use and life of materials





SO, YOU WANT TO RETROFIT YOUR BUILDING...

GETTING STARTED

You are likely reading this guide because you own a historic home or building, and you'd like to know how you can make it more energy efficient or begin on the path to NZE. Perhaps you already have a project in mind or have heard of systems like heat pumps and are wondering if it's the most cost-effective and energy efficient option for your property. The following pages will help you identify what action you can take, and how best to achieve optimal energy efficiency.



DETERMINING HISTORIC STATUS

Is my home or building considered “historic”?

Why does it matter?

My property is not considered historic. Now what?



OPPORTUNITIES FOR ENERGY EFFICIENCY IN HISTORIC HOMES & BUILDINGS

Prioritizing projects for long-term efficiency and cost-savings.

Practical approaches to energy efficiency.



PERMITTING

Determining if your project requires permitting.

Burlington's permitting process.



DETERMINING HISTORIC STATUS

IS MY HOME OR BUILDING CONSIDERED “HISTORIC”?

“Historic” properties have been evaluated for inclusion on the State or National Register of Historic Places and are listed here:

[National Register of Historic Places](#)

[Vermont State Register of Historic Places](#)

[Historic Sites and Structures Survey](#)

There are three criteria when determining historic status: age, historic significance, and integrity. If your property is 50 years or older, and can meet the other two criteria, it may be considered historic. Visit the City's [historic resources page](#) for more information.

WHY DOES IT MATTER?

Knowing whether your property is listed as historic is important information when considering any retrofit. There are special considerations and guidelines in place for projects that alter an historic building to ensure preservation of its integrity and character. Learn more about repairs and restoration for historic properties [here](#).

MY PROPERTY IS NOT CONSIDERED HISTORIC. NOW WHAT?

If your property is not currently listed as historic, it may be eligible, and there are [benefits](#) to pursuing historic status. Reach out to the [Permitting & Inspections](#) department for more information.

If you do not meet the requirements for official historic status, your home or building may warrant the same considerations when it comes to energy efficiency. In this case, this guide is still relevant and useful.



OPPORTUNITIES FOR ENERGY EFFICIENCY IN HISTORIC HOMES & BUILDINGS

PRIORITIZING PROJECTS FOR LONG-TERM EFFICIENCY AND COST-SAVINGS

[Planning for your retrofit project](#) is a critical first step in ensuring your project is efficient and cost-effective long-term. A thorough planning process will help you uncover aspects of your home or building you may not have been aware of and foster an understanding of the basics of building science before you set out on a specific project. This will go a long way in helping you avoid inefficient strategies or costly mistakes. For example, electrification is a popular topic and, in the rush to move toward it, owners may opt to pursue a heat pump for their heating or cooling needs. While this is an excellent way to reduce your reliance on fossil fuels, it may be inefficient to do so if you haven't addressed your home or building's insulation. It is recommended that insulation come before electrification, because in order for a heat pump to provide optimal efficiency and thermal comfort, your building must be sufficiently airtight.

ENERGY EFFICIENCY STRATEGIES

There are many options for implementing energy efficiency in your home or building that will serve as steppingstones on the path to NZE. These options range from simple and inexpensive to more complex and costly, and address components of your home or building and their related energy usage including:

Building Envelope

- Windows and doors
- Roof
- Insulation

Mechanical Systems

- Heating, Ventilation, and Air Conditioning (HVAC)

See the [Strategies for You Retrofit](#) section of the appendix for in-depth information on addressing these and more.



PERMITTING

DETERMINING IF YOUR PROJECT REQUIRES PERMITTING

Below are a few examples of projects that **require** a zoning permit in Burlington before the start of construction. For a full list of projects that require a zoning permit, visit the City's [Zoning Division page](#).

- New buildings or additions to existing buildings, garages, accessory buildings, or other structures.
- Alterations to building elevations/appearances including, but not limited to, re-siding or window replacement (or addition) or other changes that alter trim details or otherwise change the exterior appearance.
- Any form of demolition on the exterior of the building.
- Altering existing or construction of new porches, patios, and decks.
- Increase in habitable living space (including, but not limited to, attic, bedroom, basement, garage, and winterizing or otherwise enclosing a porch).

Below are a few examples of projects that **do not require** a zoning permit in Burlington. Find out more [here](#).

- Normal repairs, maintenance, and weatherization that do not involve any change of materials, dimensions, or design features
- Repairs required to comply with a Written Order of the Building Inspector
- Painting
- Replacement of a building feature that do not involve any change of materials, dimensions, or design features
- Tree removal on lots smaller than 3/4 acre with a single-family home
- Temporary signs, structures or uses (30 days or less)
- Design changes to the face or roof of a building (including heat pumps) that is not a historic building or within the Design Review District

PERMITTING CONTINUED

CITY OF BURLINGTON PERMITTING PROCESS

This is a simplified step-by-step overview of the process for a typical project requiring permitting in Burlington. Depending on the project, the process may take longer or have more requirements than demonstrated here. Contact [Permitting and Inspections](#) and speak with the staff about what to expect for your specific project.

01

Contact the Department of [Permitting & Inspections](#) or [apply online](#) for a Zoning Permit and pay the applicable fees.

02

90% OF ALL APPLICATIONS
RECEIVED ARE DECIDED BY STAFF
WITHIN 1-2 WEEKS.

The permit application is processed by the City's Zoning staff. Simple projects are approved administratively by Zoning staff, while more complex projects must be reviewed by the Development Review Board (DRB).

03

Application for trade permits may be made simultaneously as zoning. This includes applications for your [Construction Permits](#) (building, electrical, plumbing, mechanical, fire suppression, curb cuts, excavation, etc.).

04

Once an application has been approved, there is an appeal period required by state law before you can get your permit.

05

After the appeal period ends, your Zoning Permits may be released electronically. Be sure you have completed any pre-release permit conditions and pay any outstanding fees. Post the "Z" Card public notice where it is easily seen from the street.

06

With your Construction Permits in-hand, you can get to work!

07

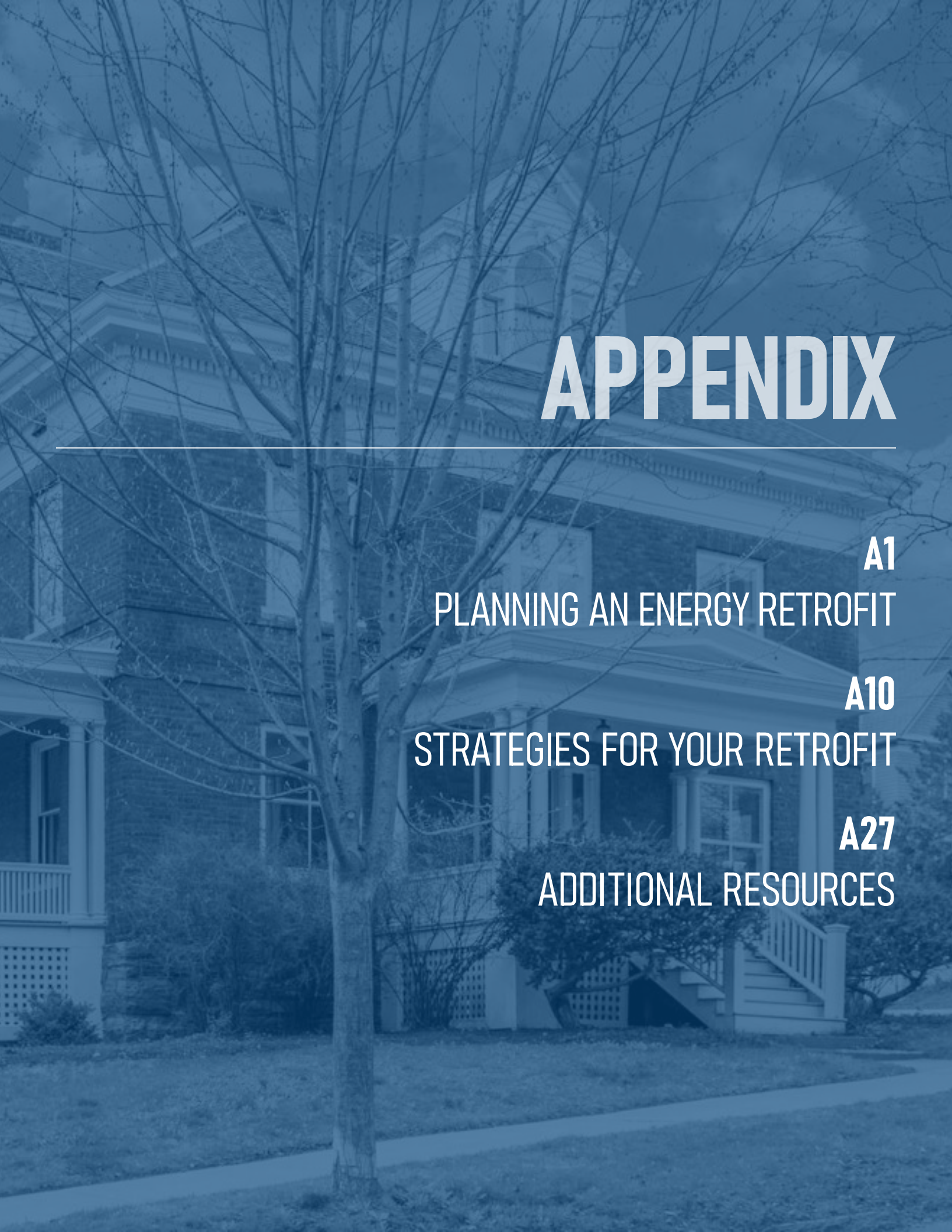
During the project one or more construction [permit inspections](#) can take place. If changes are made that alter what was approved on your Permit, consult with the Zoning staff so you understand how this may affect your permit.

08

Request a final inspection to close out your Construction Permit ([schedule online](#)). Once your Construction Permit has been closed-out, request a final [Unified Certificate of Occupancy \(UCO\)](#) from the Department of Permitting & Inspections.

09

File the Unified Certificate of Occupancy in your records and enjoy the result of all your hard work!



APPENDIX

A1

PLANNING AN ENERGY RETROFIT

A10

STRATEGIES FOR YOUR RETROFIT

A27

ADDITIONAL RESOURCES

PLANNING AN ENERGY RETROFIT

STEP 1 KNOW YOUR BUILDING

Before initiating a retrofit you must determine the buildings needs, your project goals, financing, and the best strategies to incorporate into your retrofit.

What is your building...

- Type and use
- Historic status
- Location and orientation
- Construction methods
- Character defining features
- Inherently sustainable features
- Existing mechanical systems

STEP 2 EVALUATE PERFORMANCE

Evaluating the current performance of your building envelope and systems will identify inefficiencies and help determine your priorities and goals for your retrofit.

Energy Assessment

- Measures energy use & identifies problems & solutions

Blower Door Test

- Measures the quantity & location of air leakage

Thermal Imaging

- Determine locations of air leakage or inadequate thermal insulation

STEP 3 ESTABLISH GOALS

Possible goals may include:

- Reach a specific energy usage target
- Meet code requirements or specific standards
- Reduce monthly energy costs

- Improve comfort
- Specific return on investment goals for potential renovations
- Produce renewable energy
- Meet specific air infiltration requirements

STEP 4 DEVELOP A PLAN

There are lots of sustainable retrofit [strategies](#) that are both low and high cost that can be used in your home. It's important to understand all the options available.

STEP 5 MONITOR PERFORMANCE

After implementing upgrades, your building should be monitored for performance to determine how the strategies are working and if adjustments still need to be made in the long-term.



1. KNOW YOUR BUILDING

Before initiating an energy retrofit, it is crucial that you gain a better understanding of your building. Answering the following questions will help you determine needs, project goals, financing, and the best strategies to incorporate into your retrofit.

HISTORIC STATUS

Depending on your project you may require review by the Zoning and Trades Division to assure that alterations and deep energy retrofit strategies do not negatively impact the historic character of the structure.

- Is your property listed on the State or National Register of Historic Places?

BUILDING TYPE & USE

The type of building, its use, and activities will play a large role in the type and amount of energy used and as a result, the best strategies to implement in your deep energy retrofit.

- Is your building use residential, mixed use, or commercial?
- If residential, is it single-family or multi-family?
- If commercial or mixed use, is it occupied by a retail store, restaurant, or office?

CONSTRUCTION

The most common building materials on older existing buildings in Burlington are wood and brick. Different materials and construction methods will require different retrofit and upgrade strategies to reach the same energy efficiency levels.

- When was your building constructed and what are its primary materials?
- Alterations may help you identify areas of flexibility or any areas that may need attention during the retrofit.
- Are there any noticeable alterations?
- How many stories is your building? Does it have a basement or attic? What is the roof shape and structure?

Different window materials and types may lend themselves to different retrofit strategies.

- What type of windows does the building have? What is the material?
- Are they functional?
- Are they double-hung, casement, fixed, or other?

LOCATION & ORIENTATION

Location and orientation can influence a property's visibility, sun exposure, shading, potential moisture issues and more.

- How is your building oriented towards the sun?
- Where is it located on the block or in relationship to its neighbors? Is it detached, or semidetached, part of a row?
- Where is it located in relation to a public street or way and rivers?



1. KNOW YOUR BUILDING

CONTINUED

EXISTING SYSTEMS

- How do you heat and cool your house? Forced hot air, water pipes, or steam pipes?
- Are your existing systems operating effectively?
- Did you identify inherently sustainable features that you can take advantage of for passive heating and cooling?

CONDITIONS ASSESSMENT

The assessment of the following existing conditions should occur before treatments are planned. Learn more about energy efficiency improvements [here](#).

Have the condition of your building assessed by a qualified professional to determine where there may be any active deterioration or materials in poor condition or that may have hazardous materials.

- Is lead paint present?
- What is the condition of the roof?
- What is the condition of the siding?
- What is the condition of the masonry?
- What is the condition of the windows and doors?
- What is the condition of the porch?
- Are there structural issues?
- Are there drainage issues?
- Are trees or shrubs too close to the building?

CHARACTER DEFINING FEATURES

Regardless of whether a building is designated historic, older existing buildings contribute to the character and diversity of Burlington's neighborhoods. Character is defined by the elements that make a building unique or special, including distinctive materials, features and spaces, architectural styling or design, and unique construction methods. These character defining features should be identified during the planning phase and preserved when implementing the retrofit.

- What are the unique character-defining features on your building?

INHERENTLY SUSTAINABLE FEATURES

Inherently sustainable features should be identified and incorporated into your overall plan, so they work in cooperation with other strategies implemented. These features can include operable windows, operable shutters, attic vents, storm windows, screens, awnings, porches, permeable surfaces, and landscaping. Maintaining and using these efficient features will improve sustainability and reduce unnecessary waste.

- What passive systems and inherently sustainable features exist in your building and what is their condition? Are there passive systems that could be integrated into the retrofit?

2. EVALUATE PERFORMANCE

Evaluating the current performance of your building envelope and systems will identify inefficiencies and help determine your priorities and goals for your retrofit. Your home also may be eligible for rebates for making energy efficiency improvements. The evaluation can provide an understanding of how the building is operating and will help identify improper equipment performance. It can also determine what equipment or systems need to be rehabilitated, retrofitted, or replaced. In these cases, there are opportunities for saving energy and money.

ENERGY ASSESSMENT

An energy assessment can help determine how much energy your home or building uses, where it's losing energy, and which problem areas and fixes you should prioritize to make it more efficient and comfortable. An energy assessment should be your first step before making improvements.

BLOWER DOOR TEST

Blower door tests are performed by certified energy auditors to determine to what degree a building is airtight. A temporary “blower door” equipped with a powerful fan is fitted into the frame of an existing front or back door, and when the fan is turned on, it sucks the air out of the building to find where it leaks in. Digital gauges compare the difference in air pressure between the inside air and the outside air to determine how much air is leaking into the house. The goal is to learn where your building is leaking to make it as airtight as possible to conserve energy.

THERMAL IMAGING

Thermal imaging can be performed on the interior or exterior of a building to determine locations of air leakage or inadequate thermal insulation. Addressing these locations is a productive first step in an energy retrofit.





3. ESTABLISH GOALS

Once you have evaluated your current performance it is important to define the goals and priorities you want to achieve in your retrofit. This will determine which deep energy retrofit strategies you will begin to implement into your historic or older home. You should identify your goals with the concept of “do no harm”, meaning you do not want to create new problems in the process of integrating your strategies like trapping moisture, creating condensation, or causing deterioration. There are several goals that you may want to achieve but choose the ones that apply directly to what you want and could apply to your building.

EXAMPLES OF GOALS

- Reaching a specific energy usage target or a specific percentage in reduction.
- Meeting code requirements or specific standards such as LEED or Passive House.
- Reducing monthly energy costs.
- Improving comfort and overall livability.
- Setting specific return on investment goals or payback periods for potential renovations.
- Producing renewable energy.
- Meeting project-specific air infiltration requirements.
- Transitioning to Net Zero Energy.



4. DEVELOP A PLAN

PLANNING FOR MAJOR UPGRADES

When planning a deep energy retrofit, keep in mind that there are ideal circumstances and points in time where major upgrades could save you money and time. By planning for when these conditions occur or significant replacements are needed, you may be able to include supplementary improvements at a minimal additional cost.

Major Renovation of Improvements

When planning a major renovation project or replacing mechanical equipment that is near the end of its service life, energy-efficient upgrades, such as a ground or air-source heat pump, could be incorporated at minimal additional cost.

Building Envelope Improvements

When combined with major end-of-life equipment upgrades, like HVAC, improvements to the building envelope, such as improving wall and roof insulation and weatherstripping windows and doors, can offer opportunities for reduced costs. Additional insulation and air-sealing that improve the efficiency of your building envelope could result in reduced heating and cooling loads and smaller less expensive mechanical equipment.

Life Safety & Code Requirements

When implementing life safety or code requirement upgrades that require a high cost and effort, consider installing energy-efficient upgrades that could be incorporated with minimal additional investment. This can include improved insulation, ventilation, or the implementation of energy efficient mechanical systems.

Hazardous Materials Abatement

Lead can be found in many things, but in Burlington the biggest problem is the lead-based paint used before 1978. Vermont has an extremely old housing stock, and more than 80% of the houses in Burlington can have lead-based paint hazards. For more information contact the [Burlington Lead Program](#).

Building Purchasing or Refinancing

When financing, a retrofit can be included in the transaction cost.

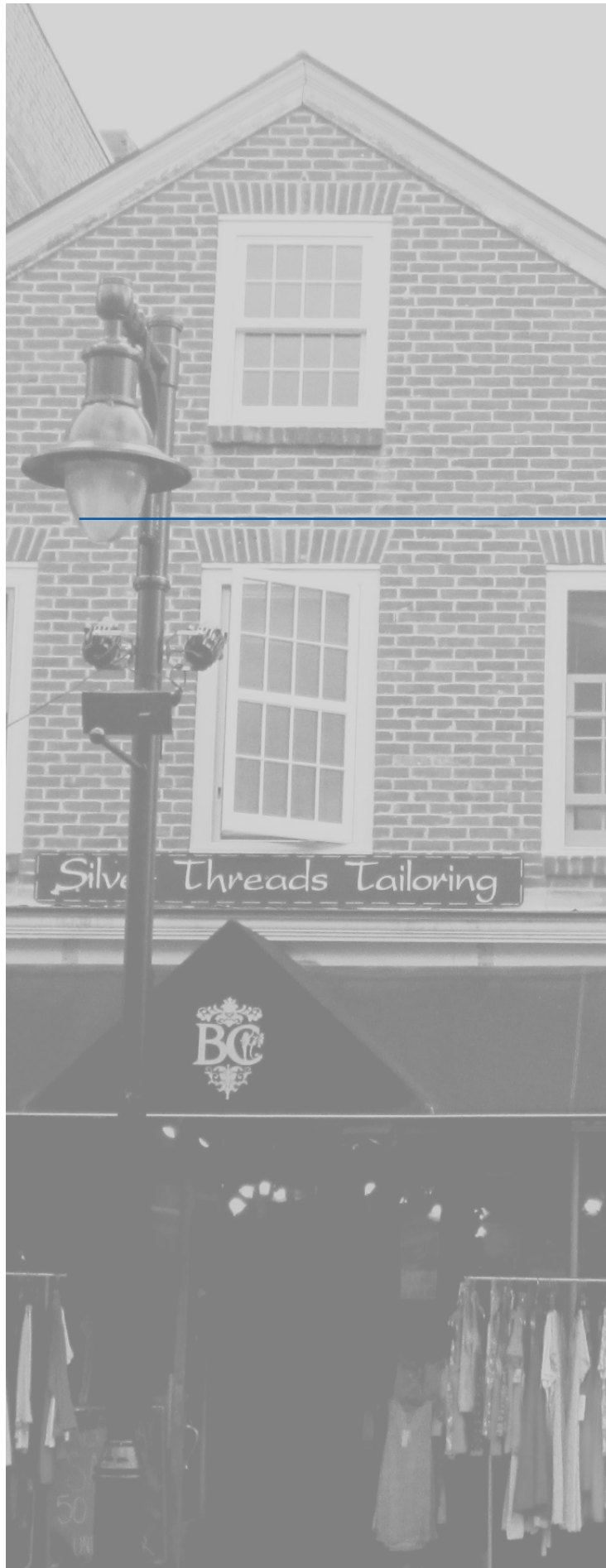


4. DEVELOP A PLAN CONTINUED

CONSIDER MATERIALS LIFESPAN & IMPACT

While considering strategies you should also recognize the lifespan of your building's materials and components, such as the following:

- Certain materials are intended to be repairable and have a long lifespan such as: masonry walls, slate roofs, and wood windows. You should try to minimize intrusions, alterations, and long-term impacts to these features.
- Passive and inherently sustainable features require little energy and maintenance to perform however, complex systems will require more maintenance to operate properly. Preserve and restore sustainable features that provide daylighting and ventilation such as windows, shutters, attic vents, storm windows, and awnings/porches.
- Consider design systems that can allow repairs and replacements without disrupting the entire building or damaging historic features. Some improvements can be very intrusive to a home especially when installing mechanical systems, consider the consequences of installing these systems if repairs or replacements take place in the future. Simple repairs to inherently sustainable features can be very effective and are less invasive and damaging to the home.
- Throughout the retrofit process, if new materials will be installed within your building it is important to be aware of the health and environmental impacts these materials may have. The following should be considered:
 - Preserve existing materials when possible. Replace with similar materials that do not disrupt the building's character-defining appearance when needed.
 - Try to use locally sourced materials when able. This makes the product "greener" by reducing transportation distances, which lowers greenhouse gas emissions.
 - Avoid building materials and products that contain toxins or have high VOC emissions.
 - Select and specify healthy building products. Seek out materials and products that are free of toxins, socially responsible and respects the rights of workers, and are sustainable with net energy positive and benefits both people and the environment.



4. DEVELOP A PLAN CONTINUED

FINANCING OPPORTUNITIES

When planning for a retrofit it is important to consider the long-term savings and ease of maintenance when budgeting. The initial cost of a product or design is only part of the true cost and owners should consider the costs and savings over the lifetime of the upgrade. Analyze prospective investments based on their expected financial and environmental benefits (maintenance savings, utility bills, comfort). There are a wide range of [incentives, resources, and financing opportunities](#) available to Burlington residents for implementing certain energy efficient upgrades.

PROFESSIONAL SERVICES

Depending on the size and scope of your project, you may want to consider consulting a professional to address specific retrofit strategies or design challenges. Larger projects require integrated teams that should be formed early in the planning process. It is also important when picking out consulting professionals that they have experience working with historic buildings AND sustainable design. You want someone who is willing to answer your questions and willing to let you be involved throughout the project. Typical professionals involved in energy retrofits include:

- Energy Auditor
- Historic Preservationist
- Licensed Architect
- Structural Engineer
- General Contractor



5. MONITOR & MAINTAIN PERFORMANCE

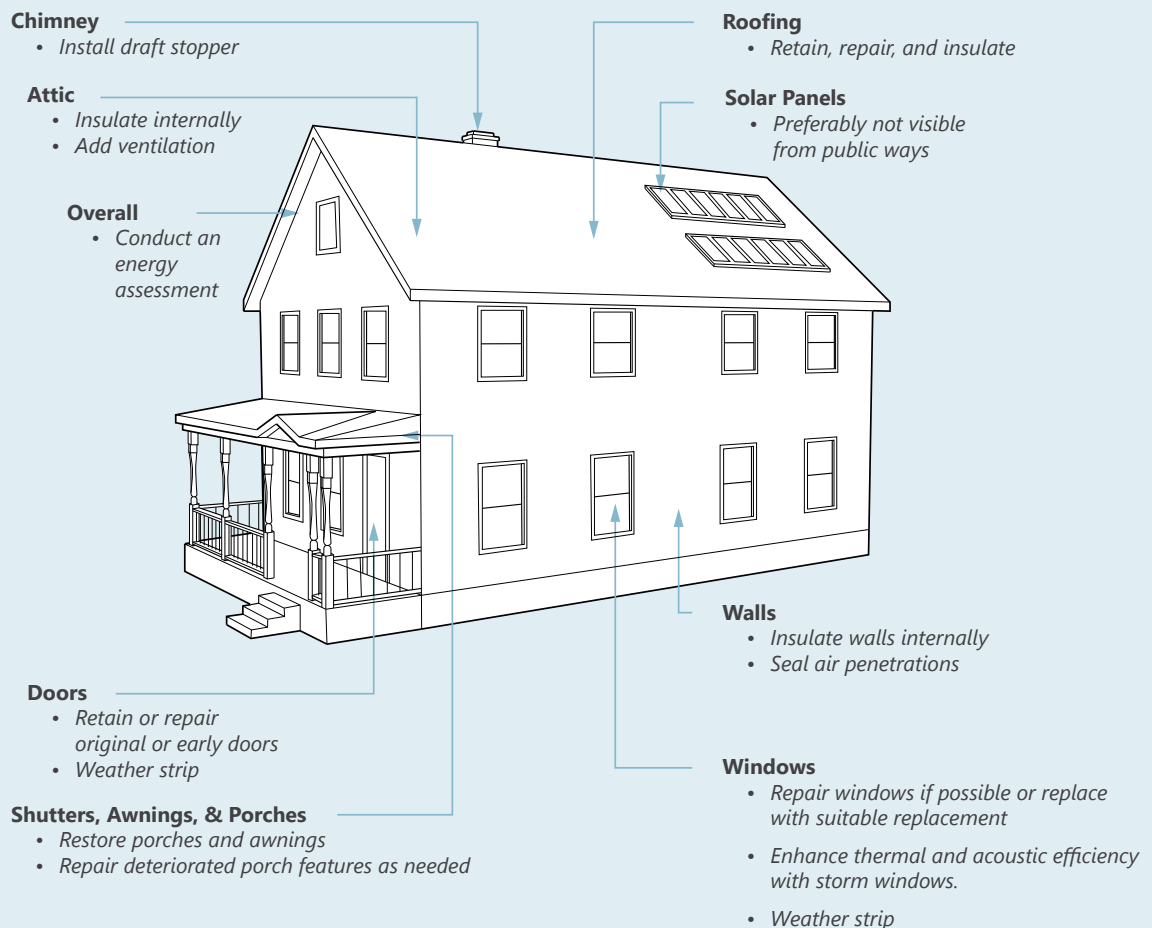
After an energy retrofit, your building should be regularly monitored for its performance to determine how the strategies are working and if adjustments still need to be made in the long-term. The Burlington 2030 District uses the [Energy Star Portfolio Manager \(ESPM\)](#), an online tool you can use to measure and track energy and water consumption, as well as greenhouse gas emissions. You can use the ESPM to manage the energy and water use of your building. All you need are your energy bills and some basic information about your building to get started.

Although it is important to monitor your building, it is equally important to maintain the improvements that have been made. Existing buildings must be maintained regularly to preserve their historic character and maximize their reliability, performance, and efficiency. This includes routine maintenance such as:

- **Gutters and Down Spouts.** Clean all debris from gutters and ground spouts.
- **Roofing and Flashings.** Clean all debris and remove any standing leaves or debris from all flashings and valleys. Check for any settling water, rust or damaged flashing or roofing materials.
- **Chimney Bases and Foundations.** Check for any cracks, loose mortar, or damaged bricks.
- **Painted Wood.** Apply any caulk or silicone as needed prior to painting. Fading and sun damaged paint should be touched up with a matching paint product.
- **Chimney Tops.** Look for loose bricks, weak mortar and flashing damages like rust. Inspect the inside of the chimney for leaks or hidden mortar damages.
- **Painted and Unpainted Masonry.** Pitted and decaying masonry, cracks or scaling should all be noted. A stiff bristled brush and some oxygenated bleach can help remove any stains or debris.
- **Mortar Joints.** Inspect all [mortar joints](#) especially where moisture may enter and where structural movements may occur for cracks, loose pieces, or spalling mortar. Mortar joints should be repointed with mortars that have the appropriate color, texture, hardness, and joint profiles.
- **Windows and Doors.** Check for any air leaks, water damage, loose panes, or crumbling glazing putty. Paint the [windows](#) and doors that are faded to prevent future damage from sun, wind, and rain.
- **Claddings (Siding).** Peeling paint and sun damage can be easily repaired with paint. Cupping, splitting, or loose nails are all signs that your siding may need some professional help. Beware of [lead paint](#) as it is common in older homes in Burlington and can be very poisonous.

STRATEGIES FOR YOUR RETROFIT

After evaluating the current performance of your building envelope and systems you will be able to identify inefficiencies and help determine your priorities and goals for your retrofit. This section discusses a variety of energy retrofit strategies that can be used to improve your buildings efficiency and is organized by building components. It provides a variety of techniques in making these improvements as well as lower and higher cost options.

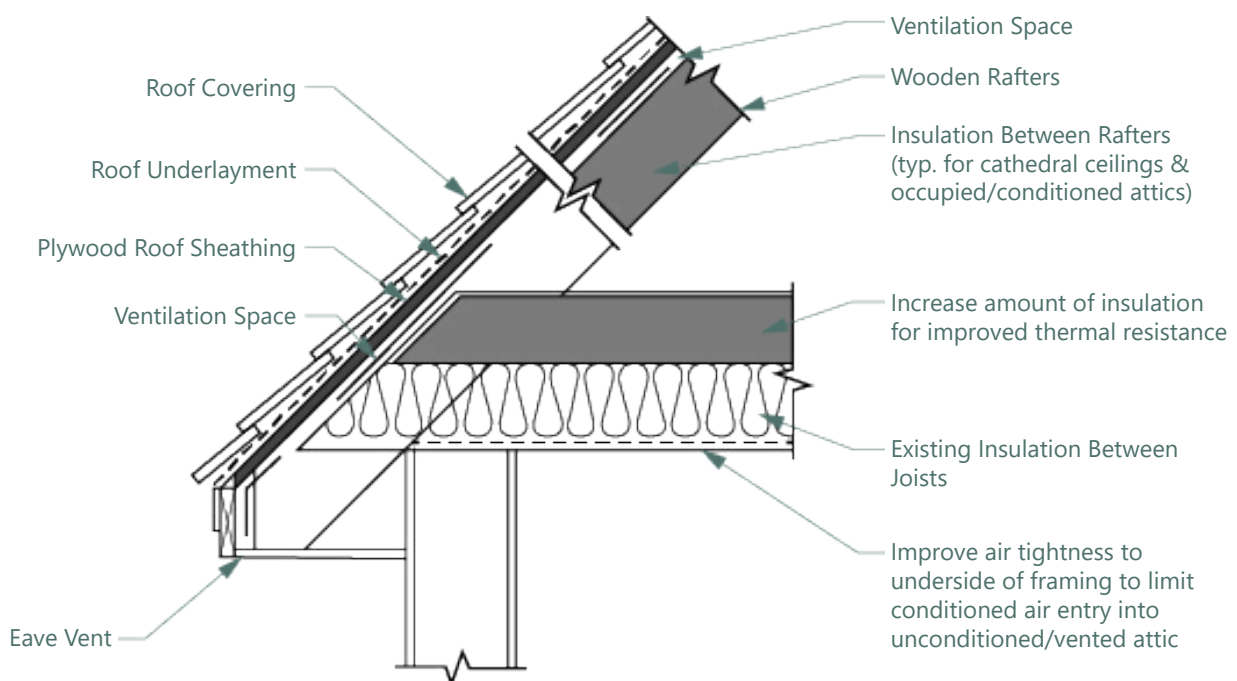


Exterior walls and roofs are the most visible components of a building, and for historic buildings are also important aspects of the building's character. Typical wall materials of older buildings in Burlington include brick and wood. Wood framed houses are generally covered with clapboard siding and shingles. Older brick buildings generally consist of multiwythe walls, meaning a wall consisted of multiple thicknesses of brick. The typical interior wall finish for both construction types is plaster on lath unless later replaced with drywall. Roofs are also often distinctive features of historic buildings. Their shape, materials, and detailing contribute to a building's appearance and character. Roofs can be flat, low-sloped, or steep-sloped and can be covered with metal, slate, asphalt, or wood shingles. Providing proper ventilation and insulation for walls and roofs is one of the most cost-effective strategies for improving the energy efficiency of older buildings. Improving ventilation and insulation are also easy to do without impacting the exterior character of older and historic buildings.

VENTILATION

A common problem that occurs when retrofitting older buildings is inadequate ventilation. Older buildings were built to “breathe” and designed to use passive ventilation but when they are sealed up for energy

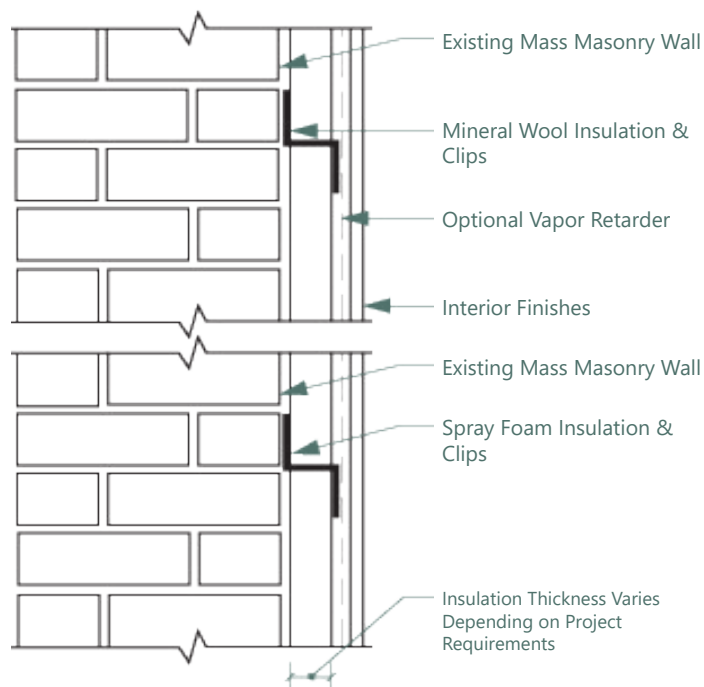
efficiency the stagnant air can cause an increase in moisture and heat build-up in interior spaces. This moisture and heat can flow into the attic when there is no dedicated air seal provided between the attic and living space below. A simple solution is venting the attic using louvers in gable ends, ridge vents, and soffit or eave vents which can increase air flow and help control moisture and heat build-up. However, venting can negate whole-building air sealing and result in energy loss from unwanted air exfiltration or infiltration. Roof eaves and attics are common areas for thermal and air barrier inefficiencies, allowing for conditioned interior air to escape. Improving the air tightness of the ceiling assembly or providing a dedicated air barrier above the conditioned space can improve energy efficiency while maintaining passive ventilation. To avoid energy loss, one solution is to install air sealing and insulation to separate the attic from interior living spaces to prevent interior conditioned air from flowing into the attic. That way attic venting can be installed to prevent moisture build-up and keep the space cooler. Improving ventilation both to attics and interior living spaces, with a combination of appropriate natural (passive) and mechanical (active) ventilation can improve air circulation, keep the building cooler, and reduce moisture build-up.



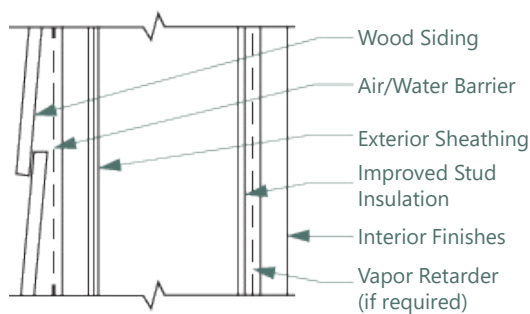
WALL INSULATION

When adding insulation to your historic building it is important to preserve the exterior walls of your home as to not affect the historic appearance. Adding continuous exterior insulation to walls may be an effective increase in thermal efficiency, however, this will typically have a harmful impact on the exterior aesthetic and character of a historic building and should not be undertaken on primary elevations. Installing insulation from the interior is the more appropriate option for older buildings. Before installing interior insulation, it is important to confirm that the installation will not cause damage to the existing historic materials.

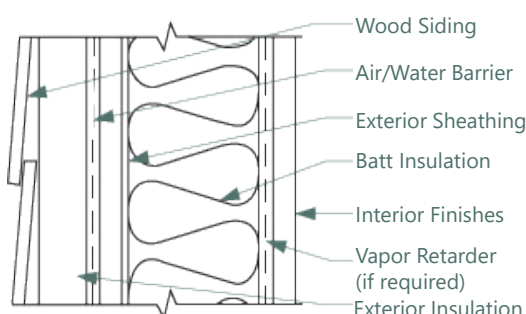
Before insulating the interior of masonry walls, you should have your home reviewed by a building envelope professional. Masonry walls are built to “breathe”, this allows them to absorb, store, and evaporate moisture on both the interior and exterior. Insulation on the interior may hinder needed evaporation, causing the wall to stay wet for a longer period and potentially leading to damage by the freeze/thaw cycle. A building envelope professional can evaluate whether an existing masonry wall is durable enough to allow for interior insulation.



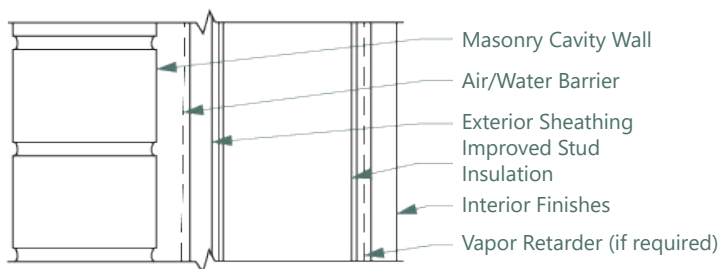
Mass Masonry Wall with Interior Insulation



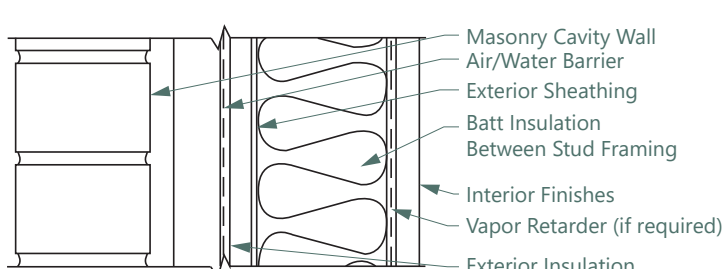
Framed Wall with Veneer



Framed Wall with Veneer



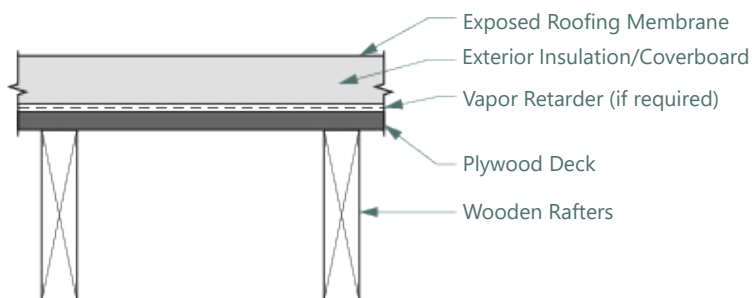
Framed Wall with Masonry Veneer



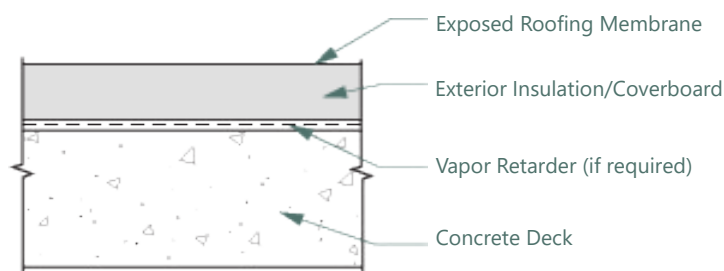
Framed Wall with Masonry Veneer

ROOF INSULATION

Insulating a roof or attic space is typically the most important step towards increasing energy efficiency within buildings. There are several options for adding additional insulation to existing roof assemblies including insulation above the roof deck, insulation below the roof deck, or insulation in the attic space below a roof. Installation of rigid insulation above a roof deck works best for low-sloped roof assemblies, a wood-framed structure typical of residential row houses. The insulation may also go below the roofing membrane. Insulation installed below the roof deck is typically used on steep-sloped roof assemblies. Insulating along the underside of the roof deck between the rafters increases the total conditioned space in the building and is required when temperature or moisture-sensitive mechanical equipment is placed in the attic space. Alternatively, insulating the attic floor with batt insulation between the ceiling joists can be used when it is not necessary to condition the attic space. Regardless of the insulation arrangement, ventilating the space above the insulation by way of eave, gable and ridge vents is critical for passive ventilation.



Wood Framed Roof Assembly



Concrete Roof Assembly

WALLS & ROOF GUIDELINES & TIPS

- Coordinate strategies with information learned from a home energy assessment.
- Consider continuous or comprehensive insulation layouts and their appropriateness for repairs, additions, and new buildings.
- Identify and preserve inherent thermal properties of the building and determine appropriate insulating measure for the characteristic features and climate.
- Evaluate material durability and expected service life of existing and replacement materials when considering repairs, rehabilitation, or replacement of walls and roofing. For example, a slate roofing shingle, which has a high upfront cost, can have a 75+ year lifetime, compared to an asphalt roofing shingle, which has a 10+ year lifetime.
- Retain, preserve, and repair character-defining features of walls and roofs, including finish materials, functional elements, and decorative features.
- Avoid making new penetrations or cuts through primary elevations, limiting air intake and ventilation through secondary elevations or through the roof. Seal new penetrations appropriately to prevent air and water entry.
- Install insulation and ventilation features so that it will not damage or result in loss of character-defining features of the building.
- New exterior wall and roof finish materials should convey a similar scale, texture, and visual appearance to those originally found on the building.
- Properties with significant historic interiors, avoid changes to the proportional relationships of wall to trim and wall to window.

LOWER COST STRATEGIES

ROOF INSULATION

- Consider adding either batt insulation in the attic floor to prevent heat gain and loss through the attic space or insulation hung along a sloped roof deck (be sure to allow for ventilation) to have a conditioned attic space.

ROOF VENTS & AIR CIRCULATION

- Provide attic vents to allow for air flow within the attic so moisture and condensation does not build-up. This could include louvers in gable ends, ridge vents, or soffit vents.
- Attic and ceiling fans can help vent and circulate air to improve the comfort of occupant.

ROOF & WALL AIR SEALING

- Evaluate areas that could have improper connections such as wall-to-roof connections. Improving these areas could reduce air leakage or heat transfer.
- Replace interior and exterior perimeter sealant, weather stripping, or loose and missing wall and roof sheathing.

HIGHER COST STRATEGIES

WALLS (WOOD FRAMED BUILDINGS)

- Provide additional wall insulation. Either from the exterior cavity insulation or interior insulation between the stud framing to increase thermal performance. When possible, provide continuous insulation without thermal breaks (such as studs or similar wall elements) interrupting the insulation.

WALLS (MASONRY BUILDINGS)

- Repoint exterior masonry to provide increased wall durability and limit the air and water infiltration to your building.
- Consult a building professional when considering insulation to avoid negative impacts to the durability of the masonry walls.

ROOF MEMBRANE

- Install a “cool-roof” membrane that reflects the sun and absorbs less solar radiation.

ROOF INSULATION

- Add roof insulation in conjunction with a roofing-membrane/system replacement project.

WINDOWS & DOORS

Windows and doors are important architectural features of older buildings in providing a sense of scale, craftsmanship, proportion, and architectural style. Historic windows come in a variety of styles and configurations and are typically constructed of wood with a painted finish. Windows require regular maintenance and repair. Replacement windows are a large expense and will only improve a limited area of the exterior enclosure. The typical ratio of fenestration to exterior wall surface area on historic buildings is around 20%, meaning the expense for full window replacements may not be a cost-effective solution given the long pay-back period based on the projected energy savings from the upgrade. Replacement windows may be justifiable if there is window failure. Upgrading the solid area of the exterior walls and roof and only performing moderate improvements to existing windows may provide better return on investment while preserving important character-defining features.

WINDOWS

Typical concerns regarding windows include operability, air infiltration, maintenance, and appearance. Generally, the appearance of a window that has not been properly maintained can seem significantly worse than its actual condition. Replacement of an entire window because of a deteriorated component, typically the sill or bottom rail, is rarely necessary. In many instances, selective repair or replacement of damaged parts and the implementation of a regular maintenance program is all that is required. It is generally possible to repair windows in fair or good condition relatively economically.

Maintenance

- Regularly review condition, repair, and repaint windows
- See NPS Preservation Brief 9 The Repair of Historic Wooden Windows

Improve Operation

- Verify that sash cords, chains and weights are functional- Install metal sliders or sash tape, balances, or operators at jambs if repair is not practical

- Repair or replace deteriorated components such as parting beads that separate window sash
- Remove built-up paint, particularly at jambs

Reduce Air Infiltration

- Replace broken glass (glazing)
- Install weather-stripping snugly between moving parts- Quality metal weather-stripping can last 20 years
- Re-caulk perimeter joints and remove and replace missing or cracked glazing putty
- Add sash locks to tighten windows
- Add interior or exterior storm window- A storm window can achieve similar R-values to a new thermal window

Reduce Solar Heat Gain or Loss

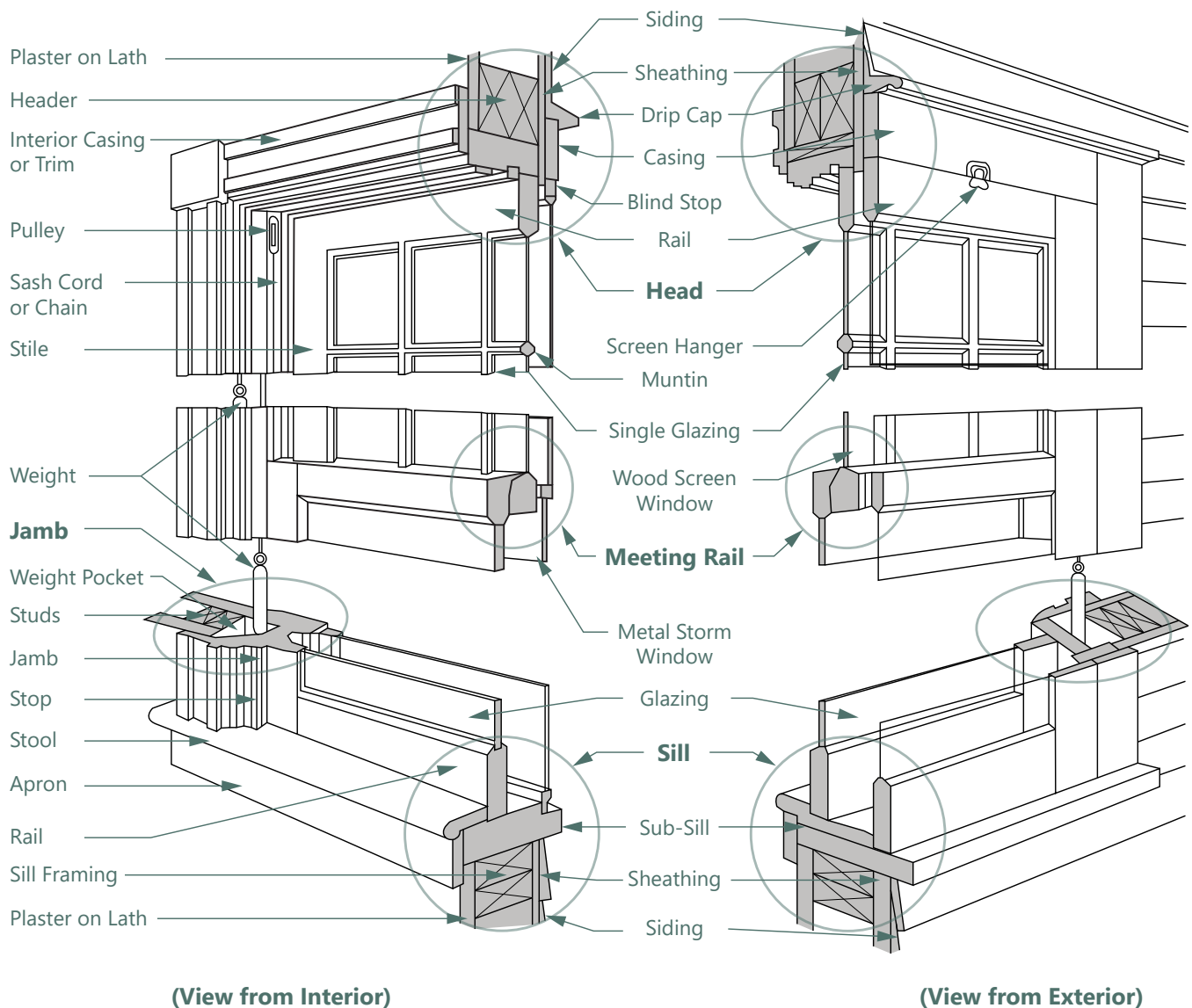
- Install and utilize operable exterior shutters where historically appropriate
- Install interior blinds, curtains, or UV window shades
- Plant deciduous trees at south and west elevations to block summer sun and allow in winter sun, and plant conifer trees at north to reduce effect of winter winds

Repair or Replace Existing Window Components

Deteriorated sills, sash and muntins are repairable by a craftsman with wood consolidate or replacement parts, retaining original fabric and function. In-kind replacement sash components and sills can be custom-made to replace deteriorated elements if necessary. Property owners are strongly encouraged to explore repair and selective replacement parts options prior to considering whole sash or frame replacement, particularly at historically significant buildings.

- **Sash-Only Replacement** - Installation of new sash in existing frame. Can include new jamb liners
- **Window Replacement Insert** - Installation of new sash and frame unit within existing opening. This typically reduces the overall size of the sash and glass, reducing interior daylight

WINDOWS & DOORS CONTINUED



Double-Hung Window Components

WINDOWS & DOORS CONTINUED

DOORS

Historic wood doors are also significant features and should be retained where possible. Historic doors have similar maintenance as windows. Regular painting and renewed weather stripping are the most effective low-cost strategies for improving energy performance. Replacement doors may have more thermal resistance, but doors are only a small area of the total exterior wall surface meaning it may not have a significant effect on the overall building energy performance. Regular maintenance and replacement of interior and exterior perimeter seals, gaskets, and weather stripping around windows and doors can significantly improve their energy performance.

Common Door Types

- **Hinged** – Swings to close at opposite jamb – almost always mounted at interior thickness of wall swinging inward
- **Double or Paired** – A pair of swinging doors that close an opening by meeting in the middle – includes French doors
- **Sliding** – Either a fixed panel with a horizontally sliding door or overlapping horizontally sliding doors – includes patio doors
- **Overhead** – Horizontal sections that open upward by sliding on tracks – most often found at garages

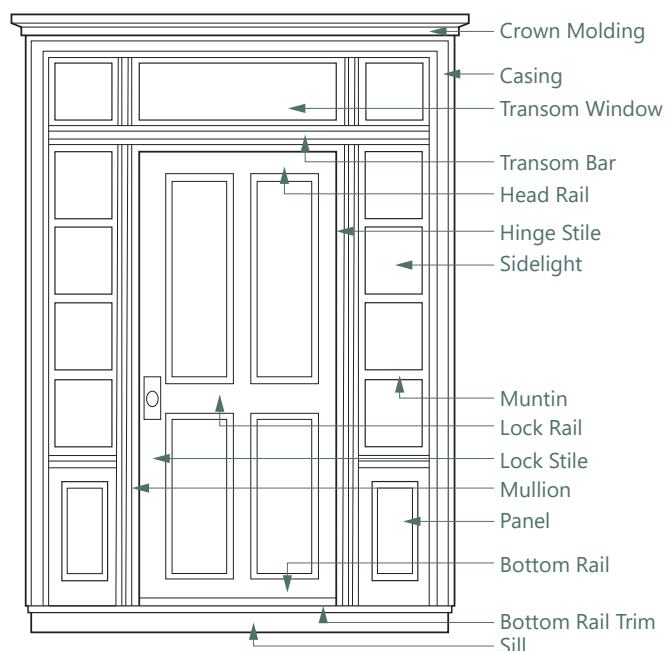
Common Door Styles

All door styles can have glazing installed in different configurations.

- **Batten** – Full height boards attached edge to edge with horizontal boards nailed to the verticals
- **Paneled** – A frame of solid wood parts with either glass or wood panels
- **Flush** – A single plain surface on its face, typically wood veneer

WALLS & ROOF GUIDELINES & TIPS

- Perform regular maintenance on older windows and doors to ensure functionality and weather tightness.
- Apply weather stripping, install storm windows and doors, and undertake basic repairs to windows and doors to improve thermal efficiency.
- Repair or reopen transoms to improve air flow and cross ventilation.
- Maintain, repair, or reinstall operational shutters and awnings.
- Retain, preserve, and repair original windows and doors unless repair is not a reasonable option.
- Replacement windows and doors on primary elevations should closely match the historic appearance. New windows and doors should fit properly within the original openings, replicate the pane configuration, dimensions and profiles of sash or door leaf, and match the finish and visual qualities of the historic windows and doors.



LOWER COST STRATEGIES

WEATHER STRIPPING

- Add weather stripping to existing windows, this can increase the energy efficiency of windows by up to 50%.
- Tighten and seal around the window and between the upper and lower sash to make the windows more energy efficient. Most of the heat loss through older and historic windows occur around the perimeter of the sash.
- Replace interior and exterior perimeter sealant and putty glazing, these components have significantly shorter lifespans than the wood and glass components.
- Use joint filler, caulk, glazing putty and sealants to seal cracks and opening on non-moving parts such as around frames and glazing.
- Use metal, silicone, rubber, or felt weather stripping on moving window elements to provide a tighter fit without sealing them shut.

LOCKING MECHANISMS

- Repair or replace locking mechanisms to prevent excess air and heat loss through the window perimeter.

WINDOW TREATMENTS

- Add interior shading or drapes to minimize heat gain or loss through windows.

HIGHER COST STRATEGIES

STORM WINDOWS/DOORS

- Install storm windows on the interior or exterior of an older window to improve thermal efficiency. Storm windows provide additional insulation in the air space between the existing window and the storm window. To be effective, ensure proper seal between both the glass and the frame and the frame of the wall.
- Install storm doors to improve the thermal performance of historic doors. Storm doors should be compatible with the appearance of the historic door, such as a fully glazed storm door with a frame that matches the existing door.

WINDOW REPLACEMENT

- If original windows are deteriorated beyond repair, replace existing windows with new insulated windows. Replacement windows should closely resemble the existing windows.
- When selecting replacement windows and doors considering choosing ones that are durable, repairable, and recyclable.

WINDOW RESTORATION

- If original windows are not deteriorated beyond repair, restoring the window is the best option for historic homes within the historic districts with original windows.

MECHANICAL SYSTEMS

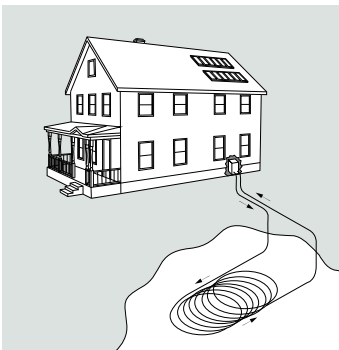
When considering installing or replacing mechanical systems in your historic home it is important to understand your options as mechanical system updates can have a large cost impact. Try to retrofit or update your mechanical systems when they are close to end of life use. Do not assume you have to replace an older system with the same type of older system. There are newer HVAC technologies that have significant benefits for historic buildings and the environment. An air-source heat pump system is one option; these systems do not necessarily require ductwork, which can be helpful when trying to limit damage to existing walls, ceilings, and building structures. These systems are also extremely quiet, energy efficient and customizable for zoned operation. Both air-source and ground-source heat pump systems do not burn fossil fuels; they use electricity to run a compressor. Ground-source heat pumps take advantage of the stable, underground temperature of the earth, ground-source heat pumps are the most efficient heating and cooling system available.

GROUND SOURCE HEAT PUMPS

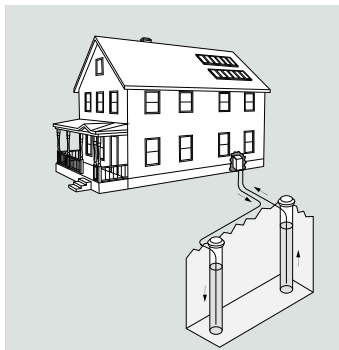
A ground-source heat pump (GSHP) is a central heating and cooling system that transfers heat to or from the ground. It uses the earth as a heat source or a heat sink. This design takes advantage of the moderate

temperatures in the ground to boost efficiency and reduce the operational costs of heating and cooling systems. A ground loop is a heat exchanger, like a cooling coil, that either extracts or adds heat to the ground. There are four types ground loop systems: horizontal, vertical, and pond/lake (closed-loop systems), and open loop. The type of system used depends on the climate, soil conditions, available land, and installation costs. The most common system for historic homes is generally vertical, closed loop.

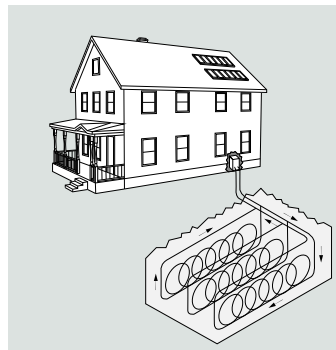
GSHPs are extremely efficient, last a long time, and are typically well suited for historic buildings because they require little equipment and are not visually intrusive to the historic character. Please note that the location of exterior mechanical unit is regulated by the zoning ordinance; and prohibited from a primary façade in Burlington. Screening may be required elsewhere. GSHP's require less equipment, have fewer moving parts, provide better zone space conditioning, and maintain better internal humidity levels than traditional HVAC systems. GSHPs can cut energy bills by up to 65%. The cost for a ground-source heat pump system can be high as they require drilling and placement of wells deep below grade, though typically, energy cost savings allow the investment to be recouped within two to ten years.



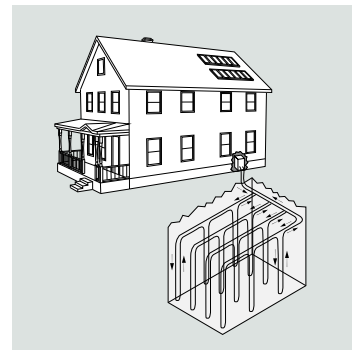
Pond/Lake Closed Loop System



Vertical Open Loop System



Horizontal Closed Loop System



Vertical Closed Loop System

AIR-SOURCE HEAT PUMPS

Air-Source Heat Pumps (ASHP) are heating and cooling systems that move heat into a home in the winter and draw heat out of the home in the summer. Instead of burning fossil fuels, they operate on the same principle as your refrigerator: using a refrigerant cycle, powered by electricity, to move heat and to keep your home at a comfortable temperature year-round. They are much more efficient than electric resistance (electric baseboard) heating and provide highly efficient air conditioning.

There are two main system types of air-source heat pumps: ducted or ductless. Ducted systems have an outdoor unit (like a central air conditioner), which is connected to an indoor air handling unit that connects to the home's ductwork. Ducted systems can work well for homes that already have ducts or where the homeowner is planning to install ducts. A version of ducted systems known as "compact-ducted" uses much smaller air handlers that usually serve two to four rooms.

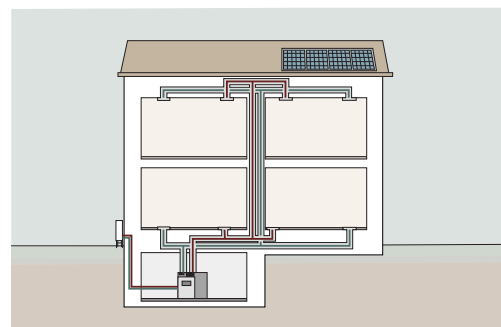
Ductless systems (including "mini-splits") have an outdoor unit which is connected to one or more indoor units (or "heads") by small copper refrigerant pipes. Each head typically serves one room or area of a house. Ductless heads can be mounted on a wall, mounted to the floor, or embedded in the ceiling. Ductless systems are a great option for houses that have no existing ductwork. Homes can be outfitted with a combination of ducted and ductless systems for a custom configuration that meets a home's needs.

The cost to install an air-source heat pump in your home will depend on the specific characteristics of the building, how much of your home's heating and cooling you want to cover with your heat pump system, the kind of system and the features you choose, and your installer. Air-source heat pumps have the lowest up-front installation cost of any low carbon heating or cooling solution and are also cost-competitive to operate compared to oil, propane, or electric heat.

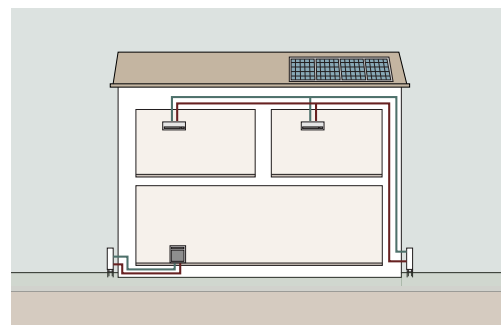
MECHANICAL SYSTEMS GUIDELINES & TIPS

- Determine which mechanical system is the best fit for your home and your home energy priorities
- Understand the costs of the mechanical system that is best for your home and plan how you will finance the project.

- Try contacting at least three installers to learn more about installing ground source or air-source heat pumps in your home. Installers may also give multiple quotes for different installation or unit configurations so you can understand all your options.
- If necessary, take preliminary measures to get your home ready for a new heating system, such as upgrading your electrical service or completing any weatherization work recommended in your home energy assessment, like sealing air leaks or installing insulation. If you are planning to improve the weatherization of your home, make sure your installer is aware so that they take the reduced heating and cooling needs of your home into account when designing your ground-source heat pump system.
- Talk to your installer about how long installation will take. Ground-source heat pump installations typically take between 2-4 weeks and air-source heat pump installations typically take between 3 days and 2 weeks, depending on home size, system complexity, and schedules of the driller and installer.



Ducted System



Ductless System

MECHANICAL SYSTEMS CONTINUED

DUCTLESS AIR-SOURCE HEAT PUMP

LOWER COST STRATEGIES

- If you're looking to use a ductless air source heat pump as your sole source of heating and cooling, an entire ductless system is going to be much more varied in cost because the required number of internal and external units will change based on the unique characteristics of your home.
- These units will have to be installed throughout the home in each zone you are looking to heat, or cool, so overall costs can range considerably.

DUCTED AIR SOURCE HEAT PUMP

HIGHER COST STRATEGIES

- Ducted (or central) systems tend to be more expensive, but more standardized in cost since the installer will simply need to replace your old air handling unit that is already connected to your existing ductwork with an air source heat pump.
- If your home does not have a duct system already, installing a complete duct network in your home will add a significant extra cost.

GROUND SOURCE HEAT PUMP

- Geothermal heating systems price varies depending on the type of loop system, vertical or horizontal are most common depending on available space. Horizontal loops are typically more cost effective than vertical loop systems, but you need adequate space to have a horizontal loop system installed.

SOLAR & GREEN ROOF SYSTEMS

There are a few different roof installations that can be implemented into your historic home that can be used to capture storm water or to generate renewable energy. Installations of such systems need to consider the building's structural capacity and architectural character.

PHOTOVOLTAIC (PV)/SOLAR SYSTEMS

Solar photovoltaic (PV) systems capture sun rays and convert the sunlight into electricity. These systems have the potential to be cost-effective and reliable producers of electricity for your home. When installing these systems in Burlington there may not be a perceptible change in the building's massing, height, or roofline, as seen from any major public street. These systems also cannot cover or obscure distinctive roof features or finishes on primary elevations. It is NOT recommended to install solar panels on slate roofs as they can be prone to damage during the installation process. If the primary roof of your building is slate, you may install solar on shed and porch roofs.

The PV system is built from solar cells, which consist of semiconductor materials that absorb sunlight and convert it into energy for immediate use or storage in batteries. There are a variety of solar cell materials available which vary in their appearance and efficiency. PV systems can be designed to meet the specific energy needs of a building and its users. Solar cells are interconnected with other cells to form flat-plate panels or modules that are installed on a building or in a rack to form a PV array. Panels can either be fixed in place or installed to track the movement of the sun throughout the day. Thin-film PVs make it possible for solar cells to double as roof shingles, roof tiles, building facades, and even glazing for skylights. These systems are new to the residential market but are increasing in popularity and effectiveness. Products such as solar roof shingles have the potential to integrate renewable solar energy in a subtle and attractive way on older existing buildings.



Solar array mounted on an historic home.



Solar shingles.

GREEN ROOFS

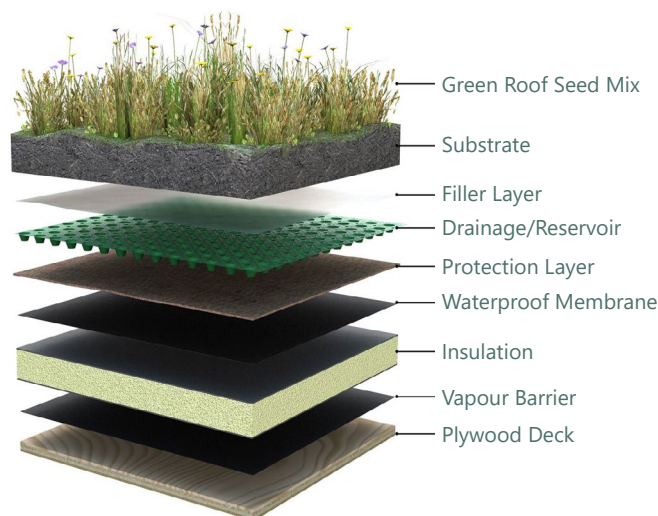
Green roofs can have many environmental benefits, they capture and slow storm water run-off, provide insulating qualities to a building, and reduce urban heat-island effect. A green roof typically includes the following components: a supporting structure, continuous waterproofing membrane, root barrier, a drainage layer/ moisture retention mat system, insulation, and soil and plantings. To provide a durable watertight long-term roofing assembly, the selection of an appropriate waterproofing membrane and the proper construction of detailing and base flashing is crucial. The soil media, insulation, and drainage/ moisture retention systems must all be designed to reduce the volume of runoff.

It's important to consult a licensed architect or engineer as a first step to determine whether the structural capacity of the existing roof can support the green roof installation. It may be necessary to supplement the existing structure. Additionally, a licensed roofing contractor or vegetative roofing supplier should be involved to assist in reviewing the relevant details, drainage, installation, and any suggested quality control measures for testing of the system.

SOLAR & GREEN ROOF GUIDELINES & TIPS

- Consult a structural engineer or architect to assess the roof's structural capacity when considering installing a green roof or roof-top solar array.

- Consult a specialist in green roofs or solar installations to ensure that the system is professionally designed and scaled for your building.
- Consider the life-expectancy of the existing roof and whether replacement should be undertaken prior to installing a green roof or solar array. The roof should be watertight and have adequate slope and drainage.
- When implementing roof installations retain original character-defining roof features and finish materials.
- Install green roofs and solar panels so that they do not result in a perceptible change in the building's massing, height or roofline, as seen from public street view, and do not cover or obscure distinctive roof features or finishes on primary elevations.
- For buildings with flat roofs, locate green roofs and solar installations back from the front edge of the roof (and from the exposed side edge for corner properties) to minimize their visibility from public street view.
- For buildings with sloped roofs, locate solar installations on secondary elevations to minimize their visibility from public street view, away from roof edges and ridges. Use low-profile panels set flush with the roof and in a complementary color with the roof finish to avoid a discordant or visually obtrusive appearance.



SOLAR & GREEN ROOF SYSTEMS CONTINUED

LOWER COST STRATEGIES

ROOF FINISH
GREEN ROOF

- Install a white roof finish to deflect sun and reduce heat gain.
- Install on a secondary building, such as a shed or garage.

HIGHER COST STRATEGIES

GREEN ROOF
SOLAR SYSTEM

- Install a green roof on the primary building.
- Install a solar photovoltaic system or solar thermal system.

LANDSCAPE & SITE FEATURES

Landscape and site features can cost effectively reduce energy use, resource consumption, and heating and cooling costs as well as improve the appearance of a property. These features can also help manage storm water and reduce heat island effect. Heat island effect is a phenomenon where extensive paved surfaces in urban areas raise the ambient temperature above the surrounding region. As a result, downtown is sometimes 10-15 degrees hotter than surrounding neighborhoods. Incorporating more vegetation in dense areas can reduce this effect.

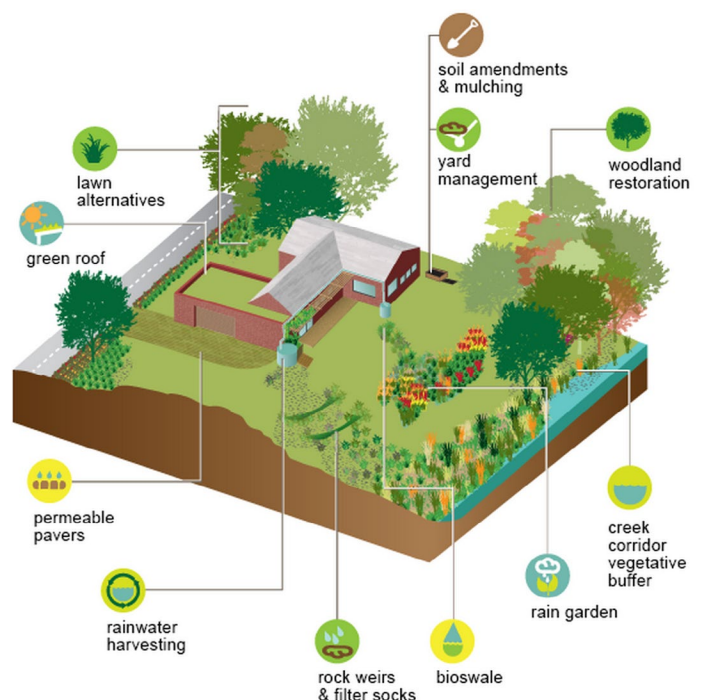
Existing landscape and site features that enhance building performance, manage storm water, and improve interior comfort should be maintained and supplemented. Strategies could include removal of paving and/or installation of permeable paving, installation of green roofs, reestablishment of tree canopy, incorporating bioswales or rain gardens and planter boxes, and rainwater harvesting. Bioswales are landscape elements designed to concentrate or remove debris and pollution out of surface runoff water. They consist of a swale drainage course with gently sloped sides (less than 6%) and filled with vegetation, compost and/or riprap. As the roofs of most buildings drain to the rear (rather than to the front) rainwater harvesting and the installation of bioswales and cisterns are most appropriate on side or rear yards. Paving should be limited in front yards to reduce impervious surfaces and to retain neighborhood character.

LANDSCAPE & SITE FEATURES GUIDELINES & TIPS

- Identify and retain existing sustainable features such as permeable paving and mature trees that block summer sun or serve as a wind break.
- Place new trees and landscaping away from foundations or basement walls to avoid moisture infiltration and damage from roots.
- Select plant and tree species according to their mature size to account for the long-term impact of mature growth.
- Prevent vines, ivy, and other plants from growing directly on the building as they can cause damage to the underlying materials.
- Consider permeable paving options when installing new or replacement paving. Avoid paving up to the building foundation with

impermeable surfaces as this can increase building temperature, cause damage to the foundation, and trap moisture.

- Ensure protection of nearby buildings, trees, site features, and known archaeological features when undertaking excavation or regarding for the installation of an underground cistern.
- Identify, preserve, and repair character-defining landscape features such as masonry walls, walkways, topographical features, plantings, or other man-made and natural features.
- Install new paving that is compatible with the character of the building and surroundings, using permeable paving if appropriate, for walkways, driveways, and patios.
- Install rain gardens, bioswales, and cisterns or other rainwater harvesting systems in a manner that is compatible with the landscape character of the property and surrounding context. Side and rear yards are typically the most appropriate place for larger landscape features that require substantial excavation or changes in topography.



Landscape and site features that can be integrated into your property to help reduce energy use and manage storm water.

LANDSCAPE & SITE FEATURES CONTINUED

LOWER COST STRATEGIES

LANDSCAPING

- Preserve existing trees and plants, particularly mature trees.
- Use native plants, shrubs, and well-placed trees to reduce water consumption and provide shade and wind protection.
- Maintain trees to promote health and avoid property damage.

COMPOSTING

- Compost food and yard scraps to enrich soil instead of using store-bought chemical fertilizers.

RAINWATER HARVESTING

- Collect and store rainfall from rooftops or other impervious surfaces in rain barrels or below ground cisterns for on-site use.
- Non-potable uses include irrigation, washing sidewalks cars or pets, refilling water features or swimming pools.

WATER EFFICIENT IRRIGATION SYSTEMS

- Install systems that reduce water consumption such as drip irrigation, soaker hoses, moisture sensors, and timers.

HIGHER COST STRATEGIES

PERMEABLE PAVING

- Install permeable paving materials to allow stormwater to filter through voids or pervious joints in the surface where it is captured in underground layers of soil and gravel.
- Examples include porous asphalt, porous concrete, brick pavers, vegetated permeable pavement, and interlocking pavers.

RAIN GARDENS AND PLANTER BOXES

- Use shallow vegetated basins or planter boxes to capture and store stormwater runoff and pass it through a filter bed of engineered soil composed of sand, soil, and organic matter. Filtered runoff may be collected and returned to a storm sewer or allowed to infiltrate into the soil.

RAINWATER HARVESTING- UNDERGROUND CISTERNS

- Install an underground cistern to collect and store rainfall from rooftops or other impervious surfaces for later use.
- Residential cisterns typically have a capacity between 1,500-5,000 gallons. Most cisterns have a standard pressurized plumbing system that conveys water to the house or wherever needed for use.



ADDITIONAL RESOURCES

GENERAL RESOURCES

- [Burlington Electric Department](#)
 - › [Net Zero Energy Roadmap](#)
 - › [Energy Efficiency Annual Report \(2020\)](#)
- [Burlington 2030 District](#)
- [Vermont Green Building Network](#)
- [Efficiency Vermont](#)
- [Vermont Gas](#)
- [Department of Public Service – Vermont Energy Saver](#)
- [City of Burlington Department of Permitting and Inspections](#)
- [Burlington Lead Program](#)

FINANCING RESOURCES

- [Burlington Electric Department Energy Efficiency Audit Program](#)
- [Burlington Electric Department Rebates](#)
- [Efficiency Vermont Rebates](#)
- [Vermont Gas Residential Rebates](#)
- [Vermont Gas Commercial Equipment Rebates](#)
- [Vermont Renewable Energy Resource Center](#)
- [VEDA Energy Financing](#)
- [VEDA Commercial Energy Loan Program](#)

HISTORIC PRESERVATION RESOURCES

- [National Park Service Preservation Briefs](#)
- [NPS Standards for Rehabilitation](#)
- [City of Burlington Historic Preservation](#)
- [State of Vermont Historic Preservation](#)
- [Building Green](#)