Corporation of the City of
NEW WESTMINSTER

Appendix A

Guide: Energy Retrofits for Heritage Homes

NEW WESTMINSTER

Energy Retrofits for Heritage Homes

Last Updated November 2023

Taking Climate Action

To help address climate change, New Westminster is committed to reducing greenhouse gas (GHG) emissions in our community by 45% by 2030 (from 2010 level) and to achieving net zero by 2050.

To achieve these goals, all buildings need to contribute, including heritage buildings. Energy retrofits for older homes can substantially reduce energy needs, increase efficiency and cut GHG emissions. Key ways to do this are by addressing air leakage, improving insulation and installing high efficiency low carbon energy systems for space heating, water heating and cooking. Preserving the heritage value of homes and their character-defining elements is also important so retrofits should be carefully planned to respect original materials and heritage features.

Sustainability and Heritage Conservation

Heritage conservation is a key contributor to sustainable communities, connecting to each of the environmental, cultural, social and economic pillars of sustainable development. In New Westminster, heritage buildings and homes are valued for their contribution to unique, characterful neighbourhoods, connections to community histories, and opportunities for economic development. Retaining and retrofitting our heritage buildings and homes also reduces deconstruction waste sent to landfills, avoids the need to create new energy-intensive materials, and instead, makes use of valuable, existing resources while lowering energy demands.

Reducing Emissions and Increasing Resilience

Retrofits in heritage buildings and homes can reduce GHG emissions but they can also increase resilience to the effects of climate change such as extreme heat events. Improving insulation and air sealing reduces the overall need for space heating and cooling in the house. Installing a low carbon fuel energy system can improve indoor air quality and may also offer air conditioning.

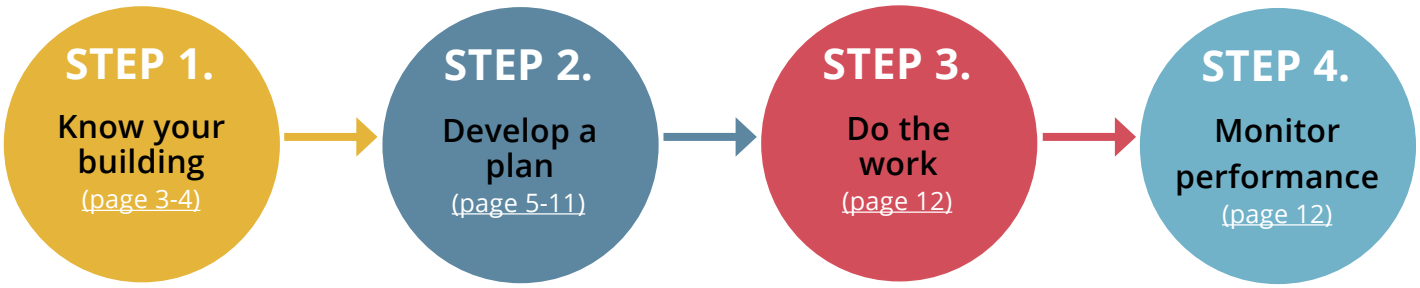
New Westminster has a diverse range of high-quality heritage houses from different eras of the city's development. Retaining historic homes and reducing their GHG emissions with appropriate retrofits contributes to positive climate action.

BOLD STEP #3: CARBON FREE HOMES AND BUILDINGS

The City of New Westminster established Seven Bold Steps for Climate Action in 2020. Among them is: *"Community carbon emissions for all homes and buildings will be significantly reduced. By 2030, all new and replacement heating and hot water systems will be zero emissions."* With 43% of emissions coming from buildings in New Westminster (2016), every home can contribute to positive climate action.

Planning an Energy Retrofit

Before selecting upgrades for a home, it is important to define project goals and develop a coordinated and informed approach. Four main steps are key to a successful energy retrofit.



Guiding Principles

There are several key principles that can help guide a successful retrofit for a heritage home:

Minimal Intervention: Minimally invasive solutions should be prioritized, especially for building features that contribute to the heritage character and heritage values of the house.

Whole Building Approach: Buildings operate as a system and should be considered as a single unit. For example, if you insulate a wall, it might also affect the windows, floors, roofs and internal air quality. Junctions and connections are particularly affected but so are systems such as ventilation and heating.

Reversibility: Newly developed materials have not been in use long enough for us to know their long-term impacts on older materials or buildings. Insulation or air sealing techniques that are not reversible might be difficult to remove in future without causing damage to historic building materials. For example, spray-foam or foam-in-place insulation are not recommended for older buildings as they may trap moisture and bond tightly to building materials.

WHAT IS AN ENERGY RETROFIT?

Home upgrades that improve the overall comfort and quality of the space in terms of energy performance, indoor air quality, and lower utility costs.

STEP 1. Know your Building

To help identify the best upgrades, it is important to understand your building and its systems, including how it may have changed over time. Explore the following aspects before starting on a plan for a retrofit:

Theme	Why is this important?	Relevant questions
Location and Orientation	Location and orientation can influence a property's, sun exposure, shading, potential moisture issues and more.	How is the building oriented towards the sun? Where is it located on a block or in relation to its neighbours?
Construction Method	Depending on the original assembly materials and past alterations, a different approach might be required than for a modern building.	When was your building constructed and what are its primary materials and assemblies? Have there been alterations over time? What type of windows does the building have and how do they function?
Character-defining Elements	Heritage value is embodied in elements that make a building unique or special, including materials, features, design, and construction methods. These elements should be identified and preserved wherever possible.	What are the unique character-defining elements of your building?
Current Systems	Your heating, ventilation and air conditioning systems (HVAC) are a crucial part of your home's energy performance. They dictate how much energy is required for these processes and how good distribution is around the house.	How do you heat and cool your house? What distribution system do you have, such as forced air, steam radiant, hot water in-floor radiant, electric resistance?
Inherently Sustainable Features	Older homes often have inherently sustainable features to take advantage of natural elements such as daylight, ventilation, and solar orientation. These types of features should be identified and maintained.	What passive systems and inherently sustainable features exist on your building and what is their condition? Are there passive systems that could be integrated into the retrofit?

Evaluating Energy Performance

An energy evaluation provided by a qualified Energy Advisor measures the current performance of the home. It can indicate priority areas and opportunities for improvements. Commonly used methods to test energy performance include:

Blower door test: Measures to what extent a building is airtight. A blower door is used to positively or negatively pressurize the building to determine the air leakage of the home and identify opportunities for improvement.

Thermal imaging: The surface temperature of a building is displayed through an infrared imaging and measurement camera to identify weaknesses in the building envelope where heat is being lost.

Working with an Energy Advisor who is knowledgeable about historical construction and retrofits in heritage homes will help you identify the most effective and compatible upgrades.

Inherently Sustainable Features

Many older homes were built before electricity, artificial lighting or powered heating were readily available or their use was managed carefully due to cost of installation and operation. Architects and builders instead often incorporated features into their designs to take advantage of naturally available options that can contribute to the sustainable operation of a home today. Some of these features include:

Windows: The location and size of windows was often chosen to optimize ventilation and control heat gain. Typically, they were designed to take advantage of passive ventilation. Double-hung windows, for instance, have operable sashes that offer control over wind movement through the building.

Landscaping: Builders often considered the tree canopy when choosing a building site as landscaping can improve interior conditions by minimizing energy use, providing shade in the summer and sun in the winter. Planting trees around buildings can reduce cooling needs by up to 30%.

Porches were designed to cool exterior walls, allow windows to be opened all year long and provide a sheltered living space.

Porches: A porch or verandah can provide shade on exterior walls. It can also increase air circulation, allowing windows to be open regardless of the weather conditions.

Attic Vents: Vents in a roof or gable and dormer windows help to circulate air, keeping a building cool and reducing moisture build-up. Dormers can also improve the functionality of attic spaces by providing natural light and increasing space.

TREES AND ENERGY SAVINGS

Planting the right tree in the right place can help manage the temperature in a house, providing energy savings. For example, larger deciduous trees such as maples may be planted on the west and south sides to offer shade in the summer. As they lose their leaves in the fall, sunlight can warm the home in the cooler months.

STEP 2. Develop a Plan

Retrofit strategies vary considerably in complexity, cost and effectiveness. Given the range of upgrades available, it is important to develop a coordinated plan based on the current energy performance, heritage considerations and the goals of the project. There are various needs and motivations for completing home energy upgrades. For example, when a gas boiler or furnace is about to reach the end of its life, it can be a good time to consider upgrading to a more efficient and low carbon system such as an electric air source heat pump (see p.10). Energy updates can also be added as part of another major project like renovating a basement, offering an opportunity to improve air tightness and increase insulation.

Consider Materials Lifespan, Impact and Long-term Cost

Unlike some contemporary products, traditional materials and assemblies can have a very long lifespan and are often repairable. Minimizing replacement and conducting regular maintenance can be good for your budget, the environment and heritage value.

Similarly, repairs on inherently sustainable features should be made first as they have high potential to provide energy savings. Environmental considerations can also be added in the selection of products by using locally-sourced materials and services when available.

The long-term costs and ease of maintenance are also important to take into account when budgeting for a retrofit. The upfront price of a product or installation is only part of the true cost. The costs and savings over the lifecycle of new equipment or materials should also be considered, as well as its likely lifespan and the timeframe for replacement.

!! Be sure to obtain all required permits before starting any work. Contact the City of New Westminster to check what permits you need.

Embodied Carbon

Retaining existing materials such as windows and doors is usually more sustainable than replacing them with new energy-efficient ones when the full carbon cost is taken into account. Retaining and reusing materials reduces waste sent to landfills and avoids the need to manufacture and transport new materials that often use a lot of energy to create. The greenhouse gas emissions generated to create, transport, install and maintain building materials is called embodied carbon.

REDUCING WATER USE

In a changing climate, water is becoming a more precious resource. Reducing water use in the home can help ensure there is enough water to meet everyone's needs. Consider some simple steps when planning a retrofit such as installing low-flow toilets, high efficiency faucets and showerheads, and adding water butts to collect rainwater for garden use.

Examine and Evaluate Potential Solutions

There are five types of upgrades that are generally considered for retrofits: air sealing, insulation, windows and doors upgrades, mechanical systems, and behavioural strategies.

Air sealing and insulation can often be done without compromising a building's heritage value and for a relatively low cost. These are important interventions to consider before other upgrades. Improving the thermal performance of the home in this way will reduce the heating and cooling requirements. Newer Heating, Ventilation, and Air Conditioning (HVAC) technologies can then be considered. They can generate more heating and cooling with less energy consumed. The HVAC equipment selected should always be right-sized and supported by a load calculation from an HVAC contractor that estimates the total heat loss and heat gain for the home. Finally, behavioural strategies can further reduce the need for energy use.

More information on each of these areas is in the following pages.

!! Beware of the potential presence of hazardous materials like asbestos.

Chimney - Insert a chimney damper or balloon into the flue.

Energy-Efficient Mechanical Systems - Upgrade old boilers and furnaces with an air source heat pump or high efficiency system.

Attic - Add insulation and reduce air infiltration areas in the attic.

Windows - Retain and repair original or historic windows. Enhance thermal efficiency with secondary glazing and weatherstripping.

Doors - Retain and repair original or historic doors. Enhance thermal efficiency with weatherstripping.

Basement - Add insulation in walls, ceilings and between floor joists. Insulate around piping and ductwork.

Walls - Add insulation.

Behavioural Strategies - Energy can be saved by adjusting behaviours such as using smart thermostats, and controlling air flow and lighting.

Air Sealing

Air flow through cracks and gaps in the building envelope cause HVAC equipment to work harder, which wastes energy and increases bills. Drafts also impact the comfort of the home. Addressing air leakage requires minimal intervention to existing materials, is typically easy to do yourself and cheap. Although you might feel drafts around loose-fitting windows and doors on the main floors of the home, significant air leaks are commonly found in the attic and basement areas and are often hidden.

Areas that might require further draft proofing include:

Attic Hatches: Weatherstrip the edges and put a piece of rigid foam board insulation on the back of the door. Treat the attic hatch like a door to the outside.

Penetration Points in the Ceiling or Roof: Weatherstrip points of penetration such as fireplaces, pipes, vents and recessed lights.

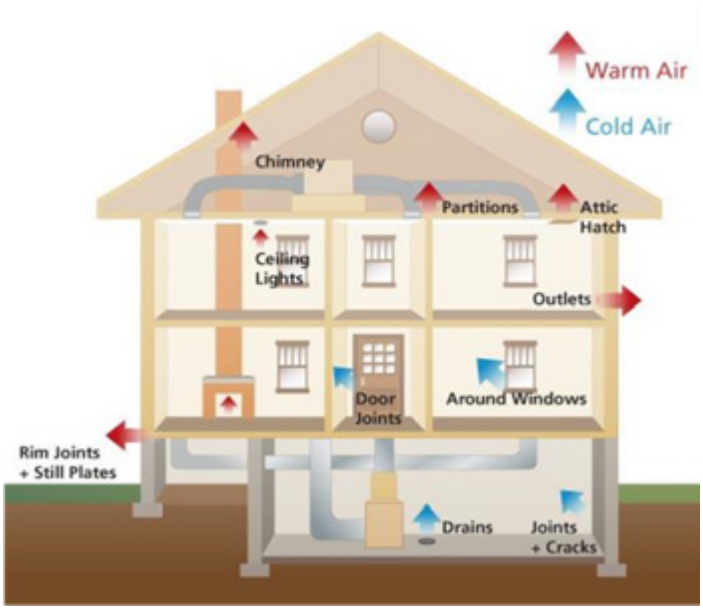
Windows: Create a complete seal around the frames and sash.

Doors: Use wiper seal for large gaps under doors.

Basement Walls: Use a silicone caulk to seal the cracks.

Baseboards and Trim: If they haven't been caulked and sealed by layers of paint they could be a source of drafts.

Electrical Outlets and Switches: Foam gaskets are recommended.



Common areas to reduce air leakage.
Source: Blank Space

BALANCING AIRTIGHTNESS AND VENTILATION

Older buildings were designed to "breathe" and sealing them too tightly through air sealing or adding insulation may create moisture issues that can, in turn, cause mould or lead wood components to deteriorate. When making a heritage home more airtight, proper ventilation strategies should be considered at each step. Areas that are particularly humid such as the kitchen and bathroom should be properly ventilated with exhaust fans.

Insulation

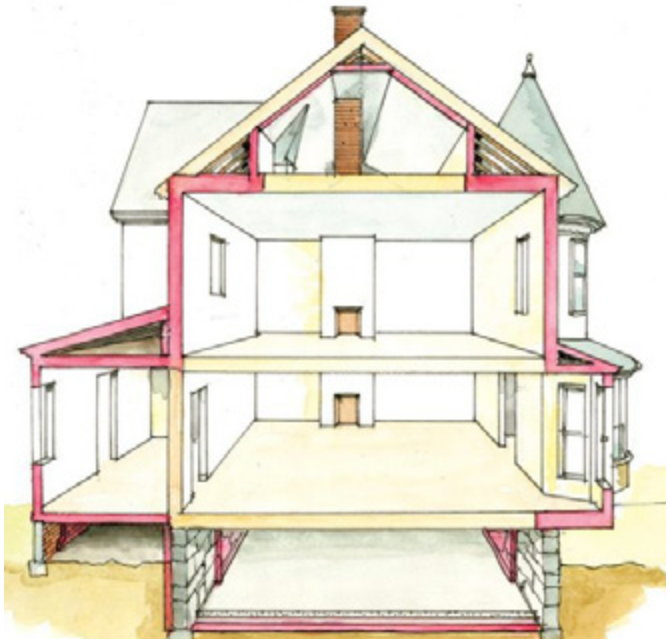
Upgrading insulation can result in greater comfort and money savings by reducing heat transmission and therefore conserving energy. The attic and basement as well as on HVAC ducts and water pipes are good places to start as they are usually the easiest areas to access without removing interior or exterior finishes. Insulating walls is more invasive and should only be undertaken by a professional. Houses more than fifty years old were typically not insulated when built. Insulation may have been added but it could still be inadequate.

Attic: After sealing cracks and gaps in the attic, add batt, rigid or blown-in cellulose insulation. There are several locations where insulation can be added: above the roof deck (when reroofing), below the roof deck between rafters or on the floor of the attic space between the ceiling joists. Regardless of the insulation arrangement, ventilating the space above the insulation by way of eave, gable, roof or ridge vents is crucial.

Foundation: Depending on the condition of the basement, different measures will be required. For an unfinished, unheated basement you might want to focus more on the ceiling to keep the living space above comfortable. Insulation can be added to the basement ceiling or between the first floor joists. For a finished basement, keep the heat in that space by focusing on insulating the walls instead.

Exposed Pipework, Valves, Boilers and Hot Water Cylinders: These can be wrapped with insulation.

Walls: Wall insulation should be part of a "house as a system" plan and should only be considered last, after insulation of the attic and basement spaces. Cellulose insulation can be blown into the cavity of a wood-framed wall from the inside or outside. For some historic construction such as balloon framing, it may not be appropriate to add wall insulation.



Where to insulate an older house.
Illustration: Rob Leanna in oldhouseonline.com

R-VALUE

Insulation efficiency is measured in R-value. The higher the R-value the more it resists heat travelling through it and therefore the more effective the insulation is.

Windows and Doors

In New Westminster, historic windows and doors contribute to the heritage character and integrity of many buildings and homes. Improving their performance can be an important part of air sealing but replacement is rarely needed to achieve a significant increase in energy efficiency. Traditionally-built wood windows and doors can almost always be repaired and they are typically very durable. With good maintenance, they can last for a very long time.

Consider these steps to improve the performance of windows and doors:

Maintenance: A simple and effective method to "green" older windows and doors is to maintain them. A well-maintained film of paint or varnish over the wood and seals in the joints sheds water and keeps the wood dry. Cleaning them regularly reduces deterioration caused by dirt, moisture, soot and pollution.

Improve Operation: Older window styles such as double-hung windows can offer maximum air circulation when used as designed. If mechanisms are working well you can achieve greater efficiency. Ensure that sash cords, chains and weights are functional or repair deteriorated components, such as parting bead that separates window sash.

Weatherstripping: Metal weatherstripping such as sprung bronze is among the materials that are considered appropriate for older windows and doors. Some are more complicated than others to install and may require professional assistance. When properly installed they require little to no maintenance.

Storm Windows and Doors: Interior or exterior storm windows and doors can significantly improve performance by adding a thermal barrier and reducing air leakage. They can also reduce noise. Thermal performance has been demonstrated as similar to double-glazed replacement windows. Both interior and exterior options are available and can be installed seasonally or left in place year-round. Exterior or interior storm windows or interior inserts can be constructed or fitted to allow opening of windows when needed.

Exterior storm windows can improve the performance of original wood windows.
Source: Vintage Woodworks

Mechanical Systems

Mechanical (HVAC) system upgrades are important for improving energy efficiency and reducing GHG emissions, and they can be done without impacting the heritage character of the house. Replacement of a mechanical system is recommended when it is close to the end of its life to avoid unnecessary waste. There are a variety of factors that go into deciding which systems are best suited for a specific house. Consulting with an Energy Advisor and HVAC contractors is recommended to find the right system for your home.

Some options to consider for mechanical upgrades include:

Heat Pumps: Electric Air-Source Heat Pumps are heating and cooling systems that move heat into a home in the winter and draw heat out in the summer. Instead of burning fossil fuels, they operate on the same principle as a refrigerator, using a refrigerant cycle, powered by electricity. They can significantly improve the thermal efficiency of a house compared with conventional electrical and natural gas systems. Heat pumps can produce up to four units of heat for every one unit of electricity.

There are two types of heat pump distribution systems: ductless and ducted. Choosing the right option depends on various criteria. For example, ducted systems may be well-suited for houses that already have ducting and vents as they can be reused for heat pumps.

Replacing an old furnace with an electrical heat pump can reduce GHG emissions.
Source: TBA

High Efficiency Furnaces and Boilers: Switching to a heat pump may not be a feasible option for every home. An upgrade to a new high efficiency furnace or boiler can still provide a reduction in GHG emissions and more effective heating, particularly when building envelope upgrades such as air sealing and insulation are completed first.

Domestic Hot Water: Another retrofit to consider is to upgrade your domestic hot water system to an energy-efficient model. Electric heat pump water heaters can significantly reduce a home's water heating energy use.

SOLAR

An installation of photovoltaic solar panels can generate electricity for use in the home and even provide excess power to the grid, reducing energy bills and contributing to clean energy generation. Due to the visual impact on the exterior of the home and streetscape, consideration should be given to the type, location and layout of the installation. Protected heritage properties including homes in a heritage conservation area may need to meet specific design guidelines.

Behavioural Strategies

Aside from physical building improvements, significant energy savings can be achieved through changes in how we use spaces and operate systems in the home. Sustainability requires a change of mindset with occupants seeing themselves as an integral part of their home's system. In designing houses, architects and builders of the past expected occupants to be proactive, adapting their habits to work with the features of the home. These practices have mostly been lost today as we generally expect homes to regulate themselves. It is possible to make a heritage house more comfortable and energy-efficient by considering small changes in habit.

Here are a few tips:

Use Inherently Sustainable Features: Take advantage of operable windows, porches, awnings and other features to reduce heating and cooling needs.

Alternate Rooms and Spaces: Control the temperature in rooms that are used and establish climate zones throughout the building with separate controls so that unused rooms are not actively regulated. You can also take advantage of the natural elements and use spaces that are more shaded in the summer and ones that are more exposed in the winter.

Adjust The Thermostat: In order to save energy, heat to a lower temperature in the winter and cool to a higher temperature in the summer. Turning the water heater thermostat down can also help. Smart thermostats that can be programmed and even adjusted remotely can help fine tune energy use.

Improve Lighting: Replace incandescent light bulbs with Light Emitting Diodes (LEDs) which use much less energy. LEDs have come down in price and can replace almost any bulb with warm or cool light options. They last up to fifty times longer than incandescent bulbs and are suitable for inside or outside use. Over their lifetime, they can pay back thirty times their initial cost. It is also possible to save energy by simply reducing the number of lights used and maximizing natural light.

!! Extreme heat events are occurring and are expected to become more frequent. In addition to energy efficiency, safety should always be the priority when regulating space heating and cooling.

STEP 3. Do the Work

Once a plan has been developed that identifies and prioritizes upgrades as part of a coordinated retrofit of the home, it is time to implement the plan. Some upgrades such as air sealing may be carried out by a homeowner while others need specialized practitioners. Identifying qualified professionals and gaining multiple quotations is recommended. For a retrofit that includes multiple upgrades, it may be appropriate to work with a contractor who can coordinate the project.

Work with a Contractor

Depending on the size and scope of the project, it might be relevant to consider working with a contractor. Networks such as Clean BC and the Home Performance Network are good resources to find qualified professionals. Seek a contractor with knowledge and experience of working with historic construction and heritage homes and buildings. To access incentives, all work must be done by a qualified professional.

Apply for Permits

Be sure to obtain all required permits before starting any work. You can contact the City of New Westminster Planning Division and Building Division to check what permits are needed. Some retrofits require a Building Permit. A Heritage Alteration Permit may also be required.

Support for New West Residents:

There are a wide range of resources and funding opportunities available for homeowners looking to do home energy upgrades. **Energy Save New West** offers guidance and rebates on energy evaluations and the latest government and utility incentives. Mechanical system upgrades in particular often have a high up-front cost. **Energy Save New West** can help you access the latest provincial rebates including those for heat pumps and other HVAC system upgrades.

energysavenewwest.ca/existing-homes/

STEP 4. Monitor Performance

After retrofits are completed, your building should be regularly monitored to determine how the strategies are working and if adjustments need to be made. Additionally, existing buildings need regular maintenance to preserve their character and maximize reliability, performance and efficiency. A maintenance plan can help guide tasks including timing and estimated costs, as well as recording contact details for relevant professionals and service providers.

This guide was researched and developed by a UBC Sustainability Scholar hosted by the City of New Westminster Climate Action, Planning and Development department.