# BC Energy and Zero Carbon Step Codes: A Builder's Visual Guide

**May 2026**

BC HOUSING

Pinna Sustainability

BERNHARDT CONTRACTING LTD.

Focal ENGINEERING

# Acknowledgements

BC Housing respectfully acknowledges that we live and work on the unceded, traditional, and ancestral homelands of hundreds of Indigenous Peoples and Nations across British Columbia, each with their own unique traditions, histories, and cultures. We are committed to building and sustaining meaningful partnerships with Indigenous Peoples, grounded in respect, collaboration, and the principles of Reconciliation.

We gratefully acknowledge the builders and industry experts who shared their experience to make this guide possible. Their lessons help raise the bar for the entire industry.

- Zosia Brown
- Shay Bulmer
- Ryan Gregory
- Nick Kardum
- Shaun Kilvington
- Joannie Kwok
- Wilma Leung
- Bruce Murdoch
- Rod Nadeau
- Clayton Parks
- Pauline Rupp
- Scott Williams

A special thanks to Pinna Sustainability, Bernhardt Contracting, and Mika Creative for their work in compiling this guide.


*Fernwood Victoria Retrofit: Builder Frontera Homes Ltd*

# Table of Contents

# About this guide

This guide gives builders practical, proven strategies for meeting higher levels of the BC Energy Step Code and Zero Carbon Step Code. Every best practice in this guide comes from real-world projects across the province, tested by builders who have learned what works and what does not.

In addition to energy efficiency and low carbon outcomes, this guide focuses on practices that are:

- **Cost-effective**, saving builders and buyers money
- **Easy to implement**, with smooth coordination among trades on site and minimal technical complexity
- **Resilient**, helping homes stand up to future climate challenges such as hotter summers, wildfire smoke, and heavy rain

Many practices in this guide recommend going beyond what is required by the BC Building Code (as of the time of publication). Where practices have strong relevance to code requirements, this guide will note that relationship. However, it remains the builder's responsibility to verify that their assemblies are acceptable practice.

This guide is also designed as a resource you can confidently reference when working with Authorities Having Jurisdiction (AHJs). By promoting consistent, documented best practices, it helps create greater alignment across local building authorities.

Some practices are detailed in full within this guide while others link to external, industry-established sources for complete technical details.

## Each practice in the guide is labelled with icons to show how it supports key goals:

**Peak Demand** - Reduces the building's peak energy demand

**Cost** - Saves builders money, or adds no cost

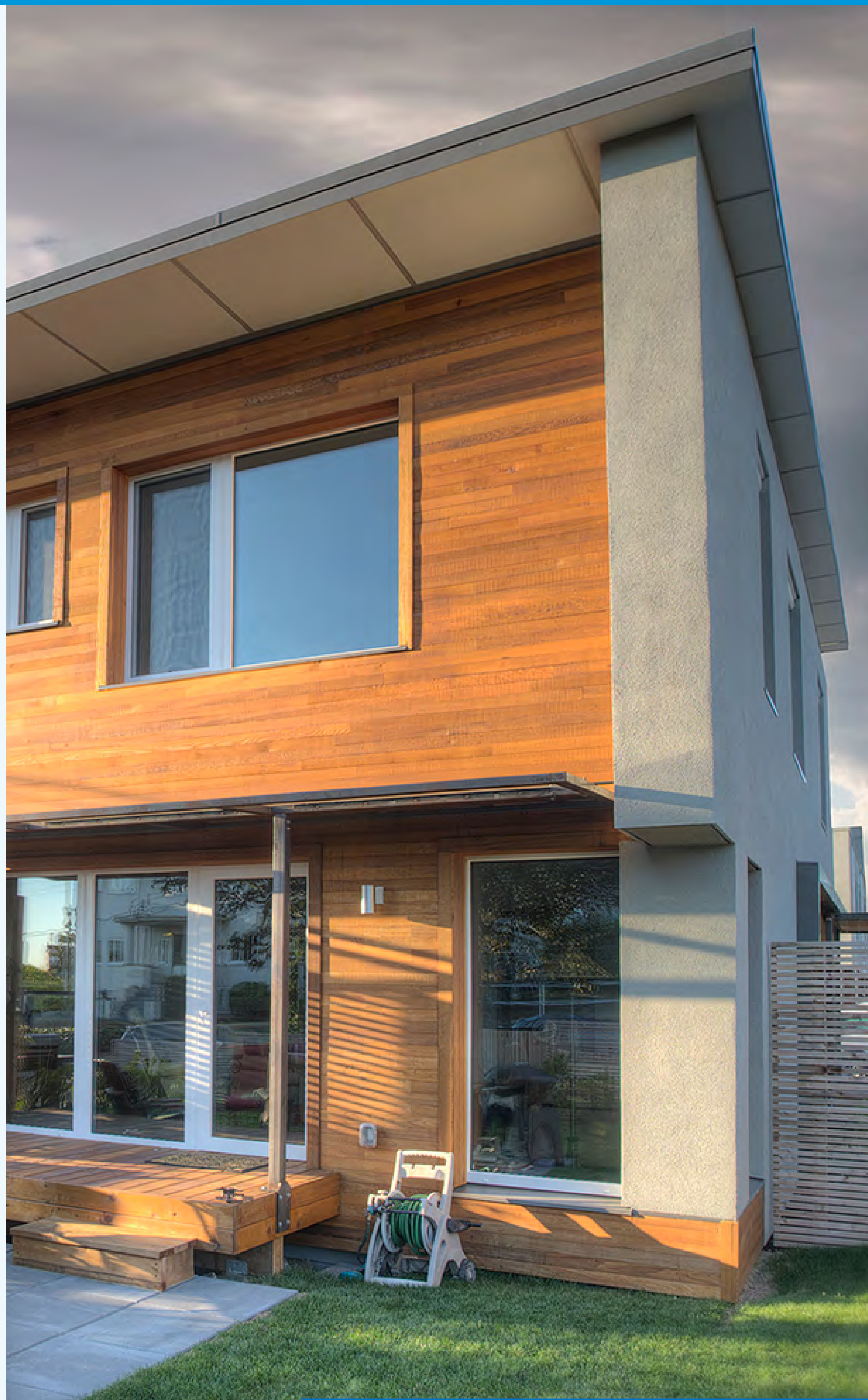
**Affordability** - Saves homeowners money

**Durability** - Helps the building last longer

**Climate Resilience** - Makes the building better able to withstand climate events like wildfire, heat, or flood

**Accessibility** - Makes building systems suited to a wider range of occupants

**Passive Design** - Reduces the energy required from mechanical systems

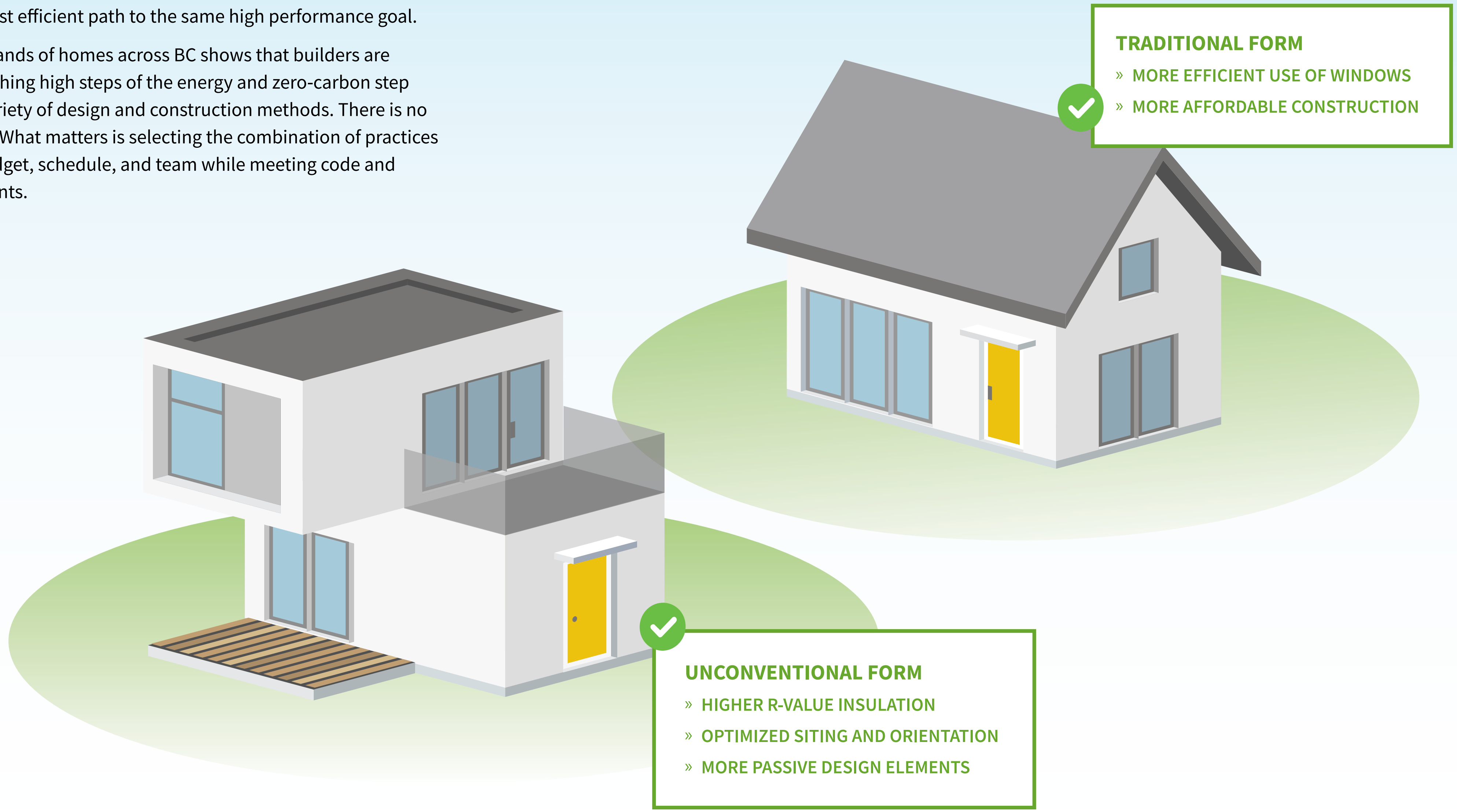


*Wilson St Passive House, Victoria; Designed by HCMA; Builder: Bernhardt Contracting*

# Proven paths to high step homes

Reaching higher step code levels is not about one complicated solution. It is about understanding your project's unique needs and choosing the most efficient path to the same high performance goal.

Data from thousands of homes across BC shows that builders are successfully reaching high steps of the energy and zero-carbon step codes using a variety of design and construction methods. There is no single right way. What matters is selecting the combination of practices that fits your budget, schedule, and team while meeting code and client requirements.



## Learning from experience: continuous improvement and natural progression

It is not realistic to expect a perfect Step 5 home on the first attempt. High performance building is a process of steady improvement and every step forward counts.

Builders who reach the highest performance levels treat every project as an opportunity to learn and refine their process. They track air tightness test results, review where issues occur, and apply those lessons to the next build. Over time, this consistent feedback loop leads to better results and fewer surprises.

> Builders should strive to make gradual improvements in their techniques.
>
> **Top photo:** An example of a builder whose technique has relied on overuse of tuck tape. This build failed its blower door test.
>
> **Bottom photo:** An example of a builder whose planning and technique has reduced the number of joints that require taping. This build achieved Step 5.

*Over the past 20 years of building energy-efficient homes, one of the biggest lessons learned has been the importance of the building envelope. Early on, we focused on different wall assemblies and air-sealing techniques, often well before they became common practice in residential construction. By experimenting with different wall systems, insulation strategies, and air-barrier details, we were able to see firsthand how small changes impacted final results, performance and costs. These early projects helped us understand that consistency in detailing and execution on site is just as critical as the materials themselves.*

*Equally important was taking the time to analyze results and costs. By tracking performance and long-term outcomes, we learned which assemblies delivered the best balance between efficiency, constructability, and value. Some systems performed exceptionally well but proved too complex or costly, while others offered strong performance with simpler, more repeatable processes. This approach allowed us to hone our methods over the years and develop proven, cost-effective strategies that reliably deliver high performance homes today.*

*- Jamie Kuhn, Pheasant Hill Homes*

*High performance home; Designed by Cascadia Architecture*

Builders' experiences show that reaching high performance rarely requires a total change in how you work. The solution can simply be a matter of rethinking the planning and how the work is done – small changes can have a big impact.

**BC Energy Step Code levels** are determined from the entire home's efficiency, as modeled by a qualified energy advisor.

**Step 3:** Often achieved with ordinary mechanical systems and a slightly improved envelope (e.g., better sealing around windows or increased insulation). This level is typically achievable, even for less experienced builders.

**Step 4:** Requires further increases in air tightness and an optimized thermal envelope. Builders reaching Step 4 tend to leverage simpler building forms and focus on air-tightness details.

**Step 5:** Relies on a well-designed and well-constructed building envelope, with deliberate focus on air tightness details, thermal control (insulation choice, thermal bridging reduction, etc.), and mechanical system design. Homes at this level have much lower energy needs to achieve the same (or superior) comfort.

**Zero carbon performance** levels generally align more easily with higher BC Energy Step Code performance. Even the least efficient fossil-fueled appliances use less energy in an energy efficient home. Builders should note that backup gas systems, fireplaces, and woodstoves are still permitted in all cases at all levels.

The guidelines below are provided as a general reference. When following the performance-based path of the zero-carbon step code, an energy advisor must be consulted to model each home's performance.

**EL-2:** When paired with Step 3 of the BC Energy Step Code, EL-2 generally requires one of the home's major systems, such as heating or hot water, to be primarily electric. Higher levels of the BC Energy Step Code allow a home more flexibility on the BC Zero Carbon Step Code.

**EL-3:** Typically requires both domestic hot water and space heating to be electrified. When combined with Step 5 Energy efficiency, gas-fired domestic hot water may still be retained in some cases

**EL-4:** Typically requires electrification of major home systems; however, limited use of gas is generally permitted as dual energy heating and as backup for purposes such as fireplaces or cooking.

**Sun shades** like this one add visual appeal without complicating the envelope and ensure that homes stay comfortable even on the hottest days.

*Photo: Smallworks, Heritage Homage*

## High performance at low cost

Achieving high performance does not have to mean expensive technology. In many cases, the biggest gains come from better planning, simpler form, and stronger envelope performance.

A common mistake is assuming that performance requires "throwing technology" at the problem, such as installing oversized, complex, or multi-fuel mechanical systems. This approach usually drives up costs without delivering the best results.

The most cost-effective path to higher step code levels starts with design and envelope performance. Before adding equipment, look at the entire design and take advantage of simple, cost-neutral or cost-savings choices that have a big impact on performance:

- **Building form**: Simplify the shape to reduce surface area (reduce articulation of the structure) and potential thermal bridges
- **Orientation**: Position the home to manage solar gain and shade
- **Window selection**: Size and place windows to balance natural light with heat loss and heat gain
- **Window to wall ratio:** Windows lose heat and add cost to the envelope. Be selective about where they provide the most value.

These decisions add minimal cost and frequently save money in the long run by simplifying construction and reducing the size and cost of mechanical systems. The practices in this guide are chosen because they are often cost-neutral or lead to savings when applied early in design and construction.

## CASE STUDY

“One of our experiences was with a Net Zero build we did in Kimberley. The prospective client wanted the home at least net zero ready but also had a budget. Local builders could only deliver Step Code 3 within the budget, and priced Step Code 5 at about $50,000 higher. The client came to us and asked if we could do a high performance home within their budget. Here are some of the changes we made:

1. Made the building less rectangular (more square).
2. Reduced corners from 8 to 6
3. Found wasted floor space in several areas and reduced the overall footprint by nearly 200 sq ft while delivering the same living experience
4. Increased the south wall overhang by 8". That allowed us to capture winter sun heat, while providing shade in the summer, thereby reducing both heating and cooling loads.
5. Installed a 1.5 ton ductless mini-split heat pump as primary heating. One head in the master bedroom and one in the open concept living area. The head in the living area does almost all the heating by itself and the other is rarely used. This was lower cost than a ducted gas or ducted electric system.
6. Used triple glazing in the windows. The added cost was partially offset by the reduced size of the solar panel array. The added comfort when standing near the windows is notable.
7. Exterior walls were composite panels, about R-38, adding to comfort and reducing mechanical loads. Savings in mechanical costs and labour because it is a panelized system.

Overall, we were able to meet the budget along with a high performance house.”

-Bruce Murdoch, Owner, K-Country Homes

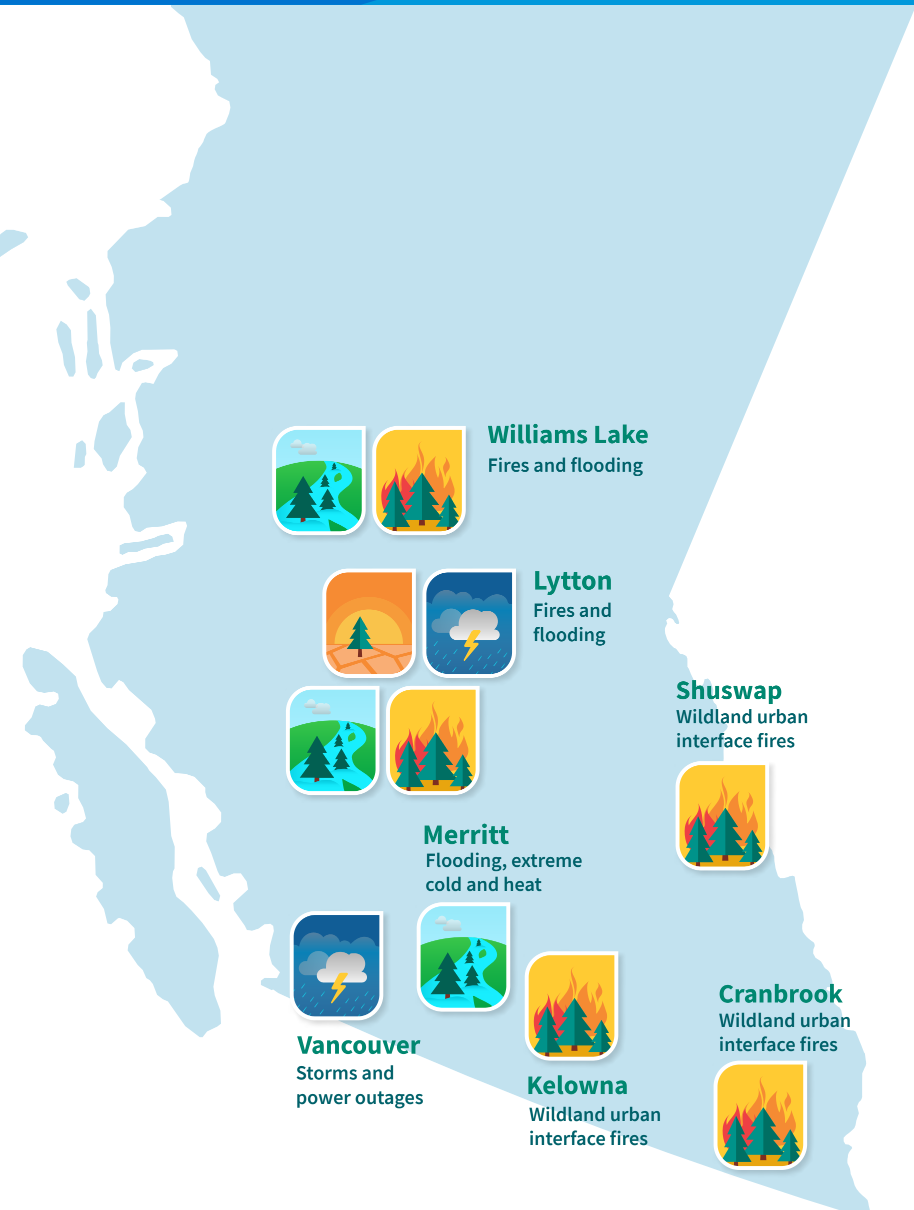



**Figure 1: The locations and causes of large and costly disasters driven by climate change are shown above.**

*Climate Costs Tracker Map (source: Canadian Climate Institute)*[2]

2 Canadian Climate Institute. 2024. "Map - Climate Costs Tracker." Canadian Climate Institute. November 5, 2024. https://climateinstitute.ca/map-climate-costs-tracker/#/.

# Building homes for a changing climate

The climate in British Columbia is changing and homes built today face conditions that are very different from those of the past. Historical design and older rules of thumb may no longer be reliable over a home's full service life.

Builders need to anticipate key changes that will directly affect how homes perform and incorporate these considerations into design and construction. Doing so ensures homes remain comfortable, healthy, and durable for decades to come.

### What the data shows

Climate change is increasing and intensifying risks from extreme weather events in B.C. Key projections[1] include:

- **Hotter summers:** More frequent and intense heat waves, increasing cooling demand and risk of overheating indoors
- **Longer dry spells:** Less summer rainfall, which increases risk and severity of wildfires, and affects indoor air quality through wildfire smoke
- **Heavier precipitation:** Increased rainfall in fall, winter, and spring, along with more severe storm events that can overwhelm drainage systems
- **Warmer winters:** Fewer days below freezing, which affects frost protection and foundation design

1 "DCRRA." 2022. Gov.bc.ca. 2022. https://climatereadybc.gov.bc.ca/pages/dcrra.

## Why building resilient housing is critical

Integrating resilience into design and construction is about protecting the home as an asset, safeguarding occupants, and reducing risk for builders and owners.

**Protecting the investment:** A resilient home that can withstand and recover from climate shocks is a more durable and reliable asset. High performance envelopes and well-designed drainage systems prevent costly water damage and failures caused by precipitation extremes.

**Ensuring occupant safety and comfort:** A well-designed, airtight building will typically remain more comfortable and safe during extreme weather events. During a power outage, the home loses heat more slowly in winter and stays cooler longer in summer. This passive defense protects occupants from the most dangerous impacts of events like heat domes.

**Meeting market demand:** Homeowners are increasingly aware of climate risks. Features like mechanical systems that filter wildfire smoke or flood-resistant landscaping are becoming strong selling points that builders can use to achieve a market advantage.

**Reducing liability:** Designing for forward-looking climate conditions instead of relying on historical averages helps prevent premature failures, costly warranty claims, and litigation tied to predictable climate events.

# Passive design

Passive design helps deliver comfortable homes through durable, proven building strategies that reduce mechanical loads and improve resilience across the seasons. By managing heat gains and losses through simple measures, passive strategies offer builders a reliable way to lower operating costs and improve long-term resilience. These approaches are often the most cost-effective way to meet energy targets and reduce mechanical loads.

## Core principles of passive design

In this guide, 'Passive Design' refers to key building principles that reduce the need for 'active' energy consumption from mechanical or electrical devices. Passive design involves aligning the building's layout, materials, and systems with the local climate to manage internal temperatures. Though modern homes will always need 'active' mechanical systems, passive design principles reduce the load on these systems, making them cheaper to buy and operate and less critical to the building's overall function. Key passive design strategies include:

- **Tightly sealed, well-insulated envelope:** Prioritizing airtightness and thermal performance to maintain a stable indoor environment and reduce heat loss
- **Solar gain management:** Orienting glazing to capture solar energy in winter, and using overhangs or shading devices to limit overheating in summer
- **Natural ventilation:** Placing operable windows to promote cross-breezes and night cooling, reducing the need for fans or air conditioning
- **Thermal mass:** Incorporating "heavy" materials like concrete or masonry inside the insulated envelope to absorb heat during the day and release it at night, helping to regulate indoor temperatures. This practice is most impactful when applied to larger structures and areas that experience rapid temperature swings. For other cases, effort is better spent on other passive principles.

## Why passive design matters

Well-executed passive design can result in measurable construction and operational savings through the following features:

- **Smaller HVAC systems:** A well-insulated, airtight building reduces heating and cooling loads, allowing for smaller, less expensive HVAC systems
- **Lower energy bills:** Passive features reduce the hours that heating and cooling systems need to operate
- **Cost-neutral or cost-saving practices:** Simple design choices, such as building form and window-to-wall ratios, can often be implemented at no extra cost, with notable benefits.

*High performance home*
*Mary St Passive house framing*

### Impact on step code metrics

Passive design directly supports BC Energy Step Code compliance. For example :

- **Compact building forms** minimize thermal bridging and reduce overall heat loss. A simple building form directly reduces heat loss and Energy Use Intensity (EUI) by minimizing exterior surface area and thermal bridging.
- **Optimized orientation and shading** control solar heat gain and improve Thermal Energy Demand Intensity (TEDI). Proper orientation and shading can reduce TEDI as well as risks associated with overheating.
- **Good airtightness and thermal performance** improve TEDI and EUI by lowering heating loads.
- **Natural ventilation** can help reduce cooling energy even though Part 9 energy modeling does not currently take it into account.

### Passive design throughout the guide

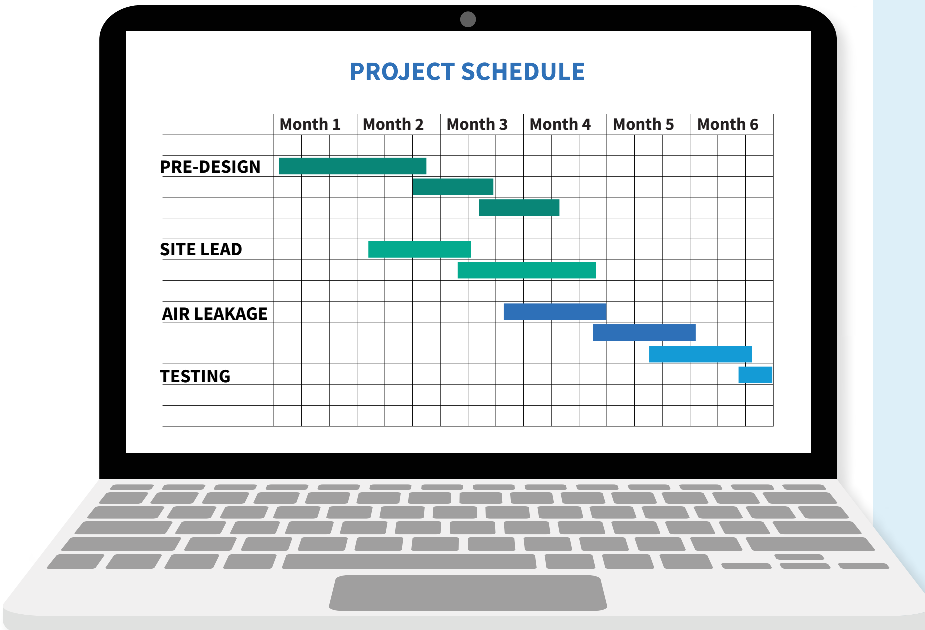
Because of its foundational role, passive design is embedded throughout this guide. Wherever passive heating or cooling strategies are discussed, they will be marked with an icon for easy identification and prioritization during design and construction.


*North Park Passive House condominium development (Part 9, Step 5), Victoria BC; Designed by HCMA. Photo by Ryan Hamilton.*

# Best practices for project coordination

The construction of a home meeting the highest levels of step code requires more than excellence with a hammer. To achieve optimal performance at minimal cost, builders must also be skilled project managers. This section covers best practices that builders can employ before ground is broken or before the day's work begins.

These are not about adding paperwork or slowing you down. They are designed to make your job easier, helping you avoid costly mistakes and rework on site. The result is a smoother build, fewer headaches, and a finished home that looks great, delivered faster and at a lower overall cost.

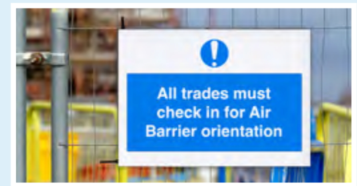



## IN THIS SECTION

Hold pre-design meetings and repeat when designs change

Appoint a site lead to oversee quality and coordinate with trades

Schedule testing and prepare the building




Address air leakage in site safety meetings

Keep client communications brief and simple

# Hold pre-design meetings and repeat when design changes

Efficient project delivery begins with pre-design. Get your homeowner, design team, energy advisor, and other trades, such as the mechanical contractor, around the table early. Focus initial meetings on identifying the project goals (e.g., BC. Energy Step Code Level, Passivehaus, etc.) and owner requirements. When everyone understands the goal and how the pieces fit together, you avoid surprises that cost time and money.

Early coordination minimizes costly site surprises, like discovering there's no room for ductwork after framing. Planning ahead for the next trade keeps the workflow smooth and prevents expensive fixes on site.

Remember that design changes ripple through the energy model and HVAC layout. Big changes can compromise performance and force costly rework. The sooner the whole team is involved, the lower that risk.

> ***If any of these change, stop and recheck performance assumptions:*** Building form, window performance specifications, insulation R-values, and passive cooling strategies are critical to performance. **Any change means you must immediately consult the Energy Advisor and Mechanical Contractor** to confirm system sizing and performance.

**Benefits:**
Lower costs

Integrating ductwork plenums into the floor truss can avoid the use of unsightly bulkheads and speed up installation for contractors.

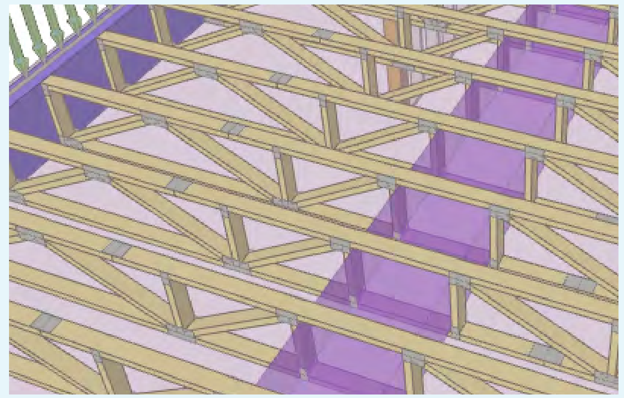
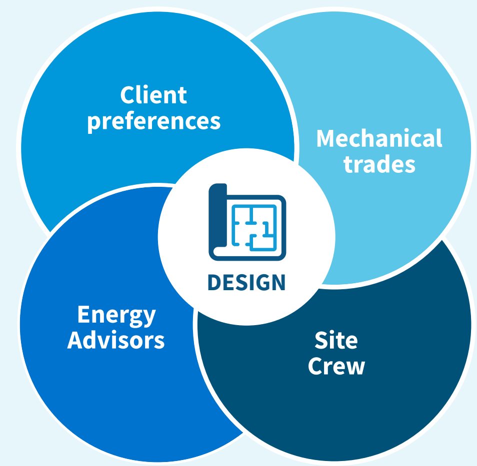


*Image: Winton Homes Ltd.*

Finally, treat mechanical systems (HVAC, plumbing, etc.) as part of the design, not an afterthought. Duct runs, pipe routing, and equipment placements should not break the air barrier or compromise insulation. Additionally, by coordinating duct runs early, you can avoid the use of unsightly and unplanned bulkheads. The payoff for this early coordination is a high performance home without last-minute scrambling or compromising the look and feel.

> *"Better homes start with a better design process. When performance targets are set collaboratively —and trade expertise is brought in early— complex problems can be identified and resolved while changes are still affordable, not after construction has begun. The Integrated Design Process is the lowest cost, most efficient way to design, and build, a home."*
>
> *- Meredith Hamstead, Co-owner, thinkBright Homes Ltd.*



# Appoint a site lead to oversee quality and coordinate trades

Assign clear accountability: **one person must take responsibility for the continuous air barrier** and **be identified to the team.** This role is often filled by a dedicated installer, site superintendent, or project manager. Whomever you choose should be a consistent presence on site who can answer questions and conduct air barrier repairs when needed.

Make sure all trades understand why the air barrier matters. Build a site culture where trades fix holes immediately or flag damage to the Quality Assurance (QA) lead. Whoever is in charge of that building element should be ready to address and correct issues quickly.

Quality control applies to more than the air barrier; it's essential at every stage. Keep your procedures simple and repeatable:

- **Test installations:** Require mock-ups for complex assemblies (like window flashing or air barrier transitions) before full installation. Alternatively, bring the site crew together to observe the first install and learn before doing the rest. This lets the team practice and troubleshoot. Multiple mock-ups can be coordinated at once to find efficiencies and reduce back and forth.
- **Deficiency tracking:** Implement a clear system, such as site photos and action lists, to log and track deficiencies until they are signed off as corrected.

**Benefits:**
Lower costs

Mockups can be done standalone (pictured above) or in-situ.

**DETAILS TO INCLUDE IN A MOCK-UP:**

- Assembly junctions
- Corners
- Windows
- Air barrier joints lacking detailed 2D drawings

# Schedule testing and prepare the building

The project manager must know the testing timeline for energy performance and air tightness and ensure the building is ready before the energy advisor arrives.

Preparation means the air barrier is fully installed, sealed, and protected, and all components (vents, access panels, etc.) are in place for an accurate test. Proper sequencing avoids costly re-testing, call-back fees, and project delays.

**TIP:** Design your schedule so testing happens at the right time and the building is 100% ready

| MON | TUE | WED | THU | FRI |
|---|---|---|---|---|
| **The Review**<br>Inspect and verify full air barrier continuity. | **Penetrations**<br>Check all electrical, plumbing, and HVAC penetrations, using specialized gaskets or high-performance tapes where needed. | **Apertures**<br>Verify all windows are shimmed and taped. Check that temporary construction doors (if present) are weather-stripped. | **Mechanicals**<br>Verify all P-traps are filled with water. Cap or seal any “open” ventilation stubs that don’t have dampers installed. | **Pre-Scan**<br>Clear all debris from the doorway where the fan will be set up. Ensure 120V power is available at that location. |
| **Site Inspection**<br>Final check for “forgotten” leaks: attic hatches, basement rim joists, and cantilevered floors. | **Contingency day**<br>Minimize work on the envelope. Prior to end of day, reverify no seals are broken or windows left open. | **Blower Door TEST** | | |

**Benefits:**
Lower costs

# Address air leakage in site safety meetings

Use your regular site meetings to address the importance of the air barrier with your team and with all new workers arriving on site. Since WorkSafe BC already requires everyone to attend a site orientation, use that first meeting to explain the basics before any tools even come out. By adding a quick talk about air leaks to your daily safety briefings, you also make sure every worker hears the same message at the same time.

Keep your instructions simple. For example:

*"This [colour] wrap is our air barrier. Please don't poke holes in it. If you see damage, tell us right away."*

**These meetings are also a good time to talk about fixing problems and keeping trades coordinated. Remind everyone how to report issues, who is responsible for fixing them, and how trades should work together.**

Consistent reminders stop damage before it happens and save you a lot of money on expensive repairs.

**Benefits:**
Lower costs

# Keep client communications brief and simple

When communicating with clients, keep instructions simple and avoid information overload. Note that while some clients will have a high interest in achieving good home performance, others will prefer hands-off ownership. In either case, it is best to provide essential advice in small pieces over multiple interactions, rather than delivering a flood of technical manuals all at once.

**Addressing active cooling hesitation**

Although the benefits of active cooling are becoming increasingly well-recognized, some clients may still hesitate. Builders encountering these clients can emphasize the improved air quality and filtration the system can provide, which is critical during the wildfire smoke season. They should also highlight the safety benefits and legal requirements. Active cooling helps keep indoor temperatures below dangerous levels during extreme heat events. This has led to code changes that make active cooling increasingly expected and, in many cases, effectively necessary in British Columbia.

Builders may also wish to compare the cost of cooling an entire building with the cost of cooling a single space. In practice, the difference in cost between the two approaches is often small.

**Focus on key operational tips**

During handoff, share simple, high impact tips that affect both comfort and energy use. A great example is temperature setpoints**.** Homeowners new to high-efficiency systems should know it is much more efficient to adjust temperatures gradually (one or two degrees at a time) rather than making large, sudden changes. Traditional nighttime setbacks often do not apply to higher performance homes, and many homeowners may not know this.

**Benefits:**
Climate resilience

**Deliver this information in digestible bits** as the project progresses, then reiterate on handover day, involving trades if needed to run through mechanical systems. This approach improves retention and reduces call-backs for the contractor.

# Best practices for design

High performance homes start with high performance design. Even the best builders can't hit higher step code targets if the design is weak. Real-world challenges like fixed lot sizes and tricky orientations make early best practices even more important.

This phase locks in decisions about materials, assemblies, and layout. Many best practices focus on the building envelope, especially the air barrier and insulation strategy. Smart design and planning for mechanical system layout and siting is equally critical to avoid conflicts and maintain performance.

## IN THIS SECTION















# Use key passive building elements

Early design decisions around siting, windows and shading can significantly influence energy performance and occupant comfort. Strategies include:

- Where site conditions allow, orient the building along the cardinal axes and prioritize shaded glazing on the south side for winter solar gain and summer shading
- Add fixed or operable exterior shading devices suited to window orientation and room use
- Locate main living spaces near these south-facing windows for improved daylight, comfort and efficiency

These strategies are cost-effective and improve performance across all BC Step Code levels. Skipping them often means spending more on other building elements and increasing overall project cost.

**Benefits:** Lower costs; Passive; Manages demand; Accessible

# Keep the shape simple

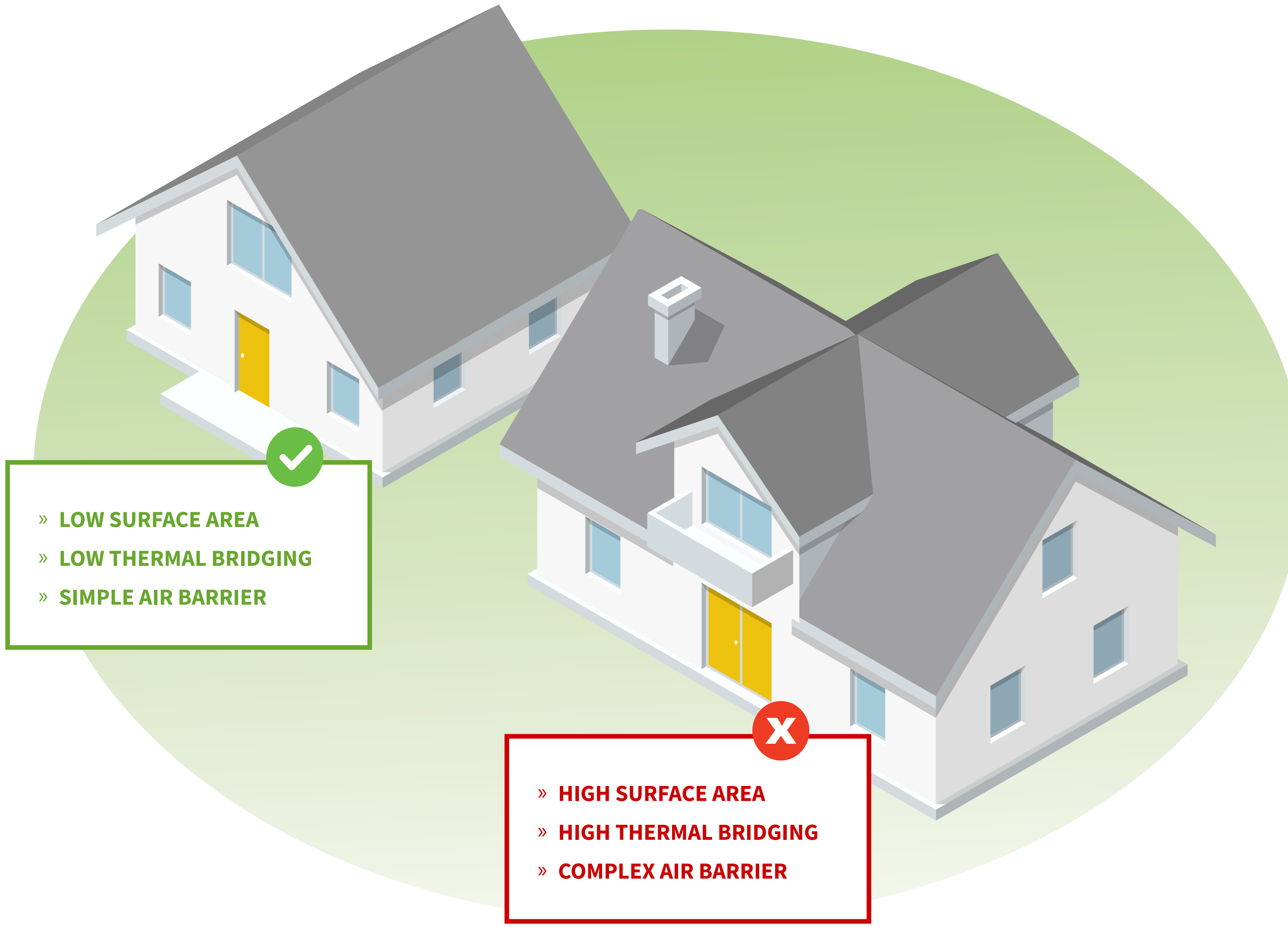
The amount of exterior surface area directly affects energy loss. Buildings with fewer corners and projections are easier to air seal, less prone to thermal bridging, and generally more affordable to construct.

As a general rule, simple shapes also reduce design and construction complexity, leading to more affordable builds.

Note that simple shapes don't need to mean boring designs. Architectural interest can still be achieved through porches, pergolas, and shading elements without interrupting the continuous air barrier and insulation. This allows builders to 'decorate around the envelope' rather than relying on envelope complexity to create visual interest. The form can remain compact, high performance can be easily retained, and costs are kept low both for the client and for the builder (who avoids the risks associated with complex assemblies).

**Leverage standardized designs:** Federal and provincial standard designs can be an excellent starting point for efficient design and can lead to faster approval times.

**Benefits:** Lower costs; Manages demand



# Use windows wisely

Windows should be sized and placed to support daylight, views, natural ventilation, and connection to the outdoors while balancing energy performance and cost.

Windows lose heat quickly in winter and allow heat in during summer, adding to mechanical energy loads, but they also provide natural lighting and views of B.C.'s landscapes. Although modest window-to-wall ratios are best for performance, extensive resort-style glazing can sometimes meet performance metrics if energy efficiency is prioritized elsewhere. The key is to balance all of these outcomes in a way that gives the best results for the project's needs.

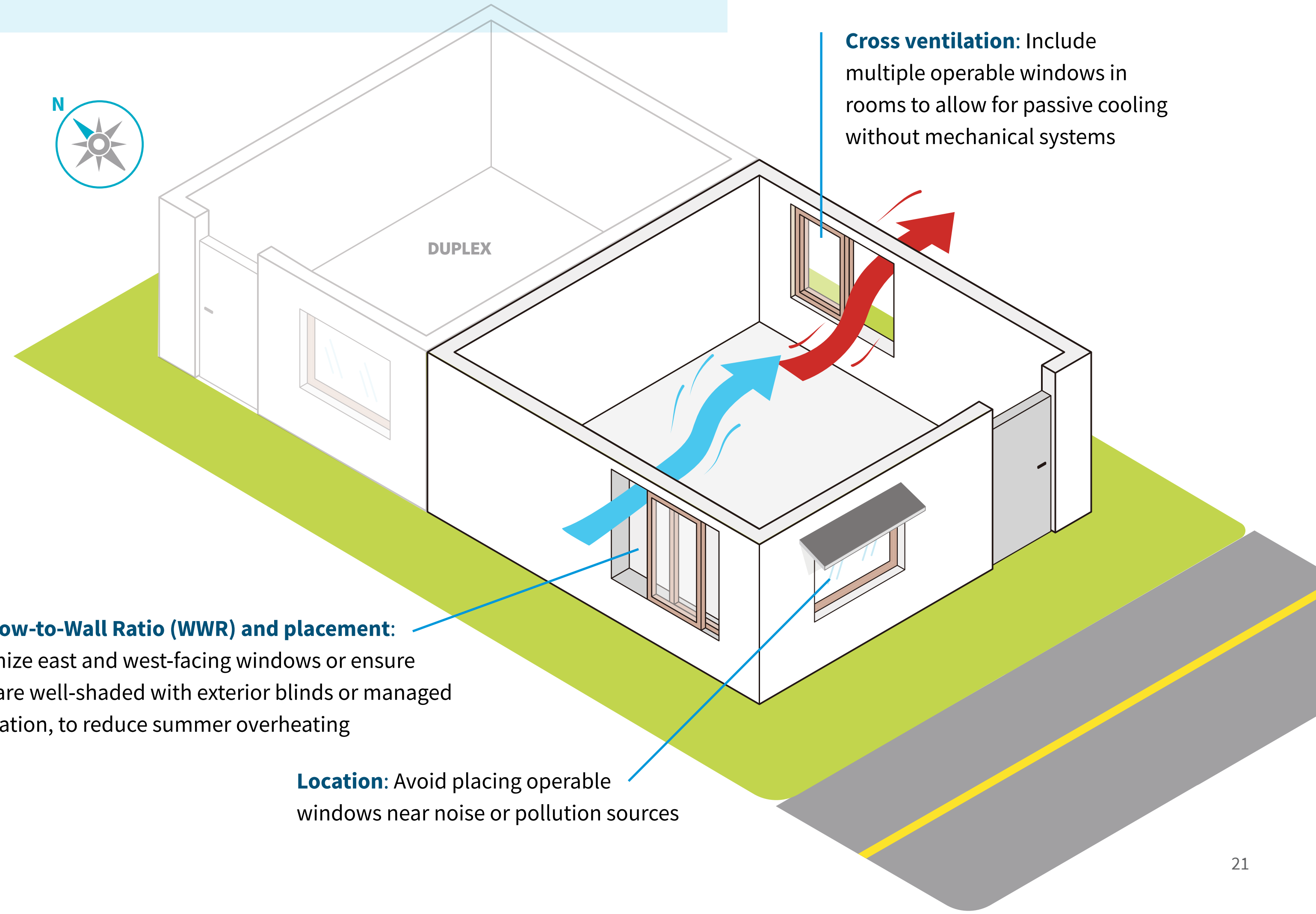
When the design follows energy-conscious principles, standard double-pane windows often suffice. If larger windows are preferred, consider triple pane, vacuum glazing, or other specialty options to maintain performance.

Be cautious about relying on solar gain to improve TEDI scores, as this can increase summer overheating, especially with low-e coatings that trap heat. Balancing winter gains vs summer cooling is a key component to creating a comfortable, efficient home.

> **HOT2000 energy modeling** does not currently account for the benefits of operable windows and cross ventilation, but occupants will appreciate the comfort and energy cost savings.

**Benefits:**
Lower costs

> **Passive cooling strategies** such as opening windows at night and closing them during the day, along with using blinds or shades, are not widely known in B.C. Educating homeowners on how to use windows for passive cooling can improve satisfaction and reduce energy use. If cross-ventilation was considered during design, it is helpful to show homeowners how operable windows can provide the greatest benefit.




**Cross ventilation**: Include multiple operable windows in rooms to allow for passive cooling without mechanical systems

**Window-to-Wall Ratio (WWR) and placement**: Minimize east and west-facing windows or ensure they are well-shaded with exterior blinds or managed vegetation, to reduce summer overheating

**Location**: Avoid placing operable windows near noise or pollution sources

# Plan the air barrier from the start

Installing the air barrier on flat wall sections is straightforward, but achieving high performance airtightness requires careful attention to complex assemblies and junctions.

Transitions between different assemblies are the most common sources of leakage. These include wall-to-ceiling connections, corners, window and door penetrations, and overhangs. A continuous seal in these locations is essential for meeting the higher BC Energy Step Code levels.

To avoid ineffective installation and costly rework, finalize a clear installation plan before construction begins. The best time for this planning is during the design phase, working with the building designer and specialty trades. Request and share simple diagrams of the air barrier strategy and distribute these to on-site teams. This upfront effort saves labour time and money throughout the project.

Key risk areas:

- Wall-to-roof transitions
- Corners and assembly junctions
- Window and door penetrations
- Overhangs and other discontinuities
- Pot lights and penetrations for electrical systems

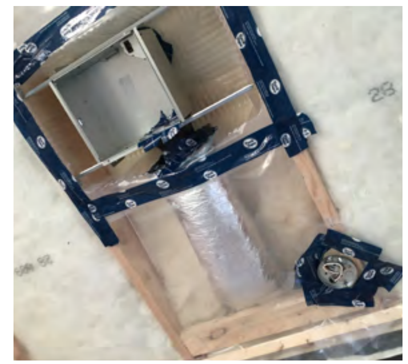
**Benefits:** Durability; Passive; Manages demand


**Top Left:** Sealing around floor joists

**Top Right:** Sealing and taping around internal corners

**Bottom Left:** Sealing around electrical penetrations

**Bottom Right:** Sealing around external corners and at foundation joint



*"I truly believe that good airtightness is the biggest bang for your buck and contributes to comfortable and resilient homes. Of all the things builders can do to improve, the building envelope airtightness is the cheapest and easiest to integrate into your building process."*

*- Brian Charlton, Co-owner, JB CHARLTON HOMES*

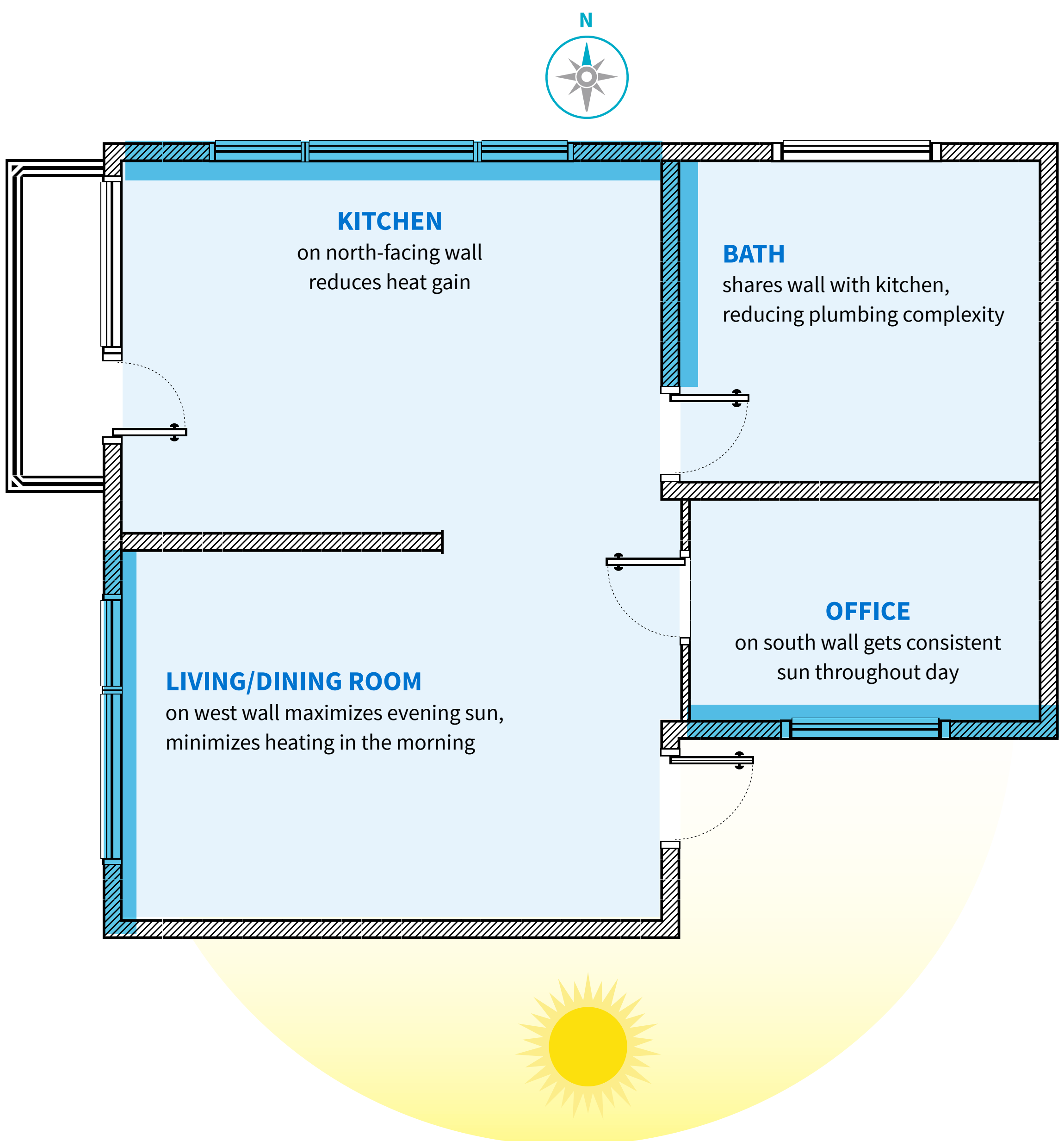
# Optimize building and space layout

Effective space planning is one of the easiest and lowest cost methods to improve comfort and reduce energy demand. Focus on rooms that matter most: living spaces where people spend time during the day and bedrooms where they sleep at night. These spaces are not generally used at the same time, so a smart layout can prioritize comfort in the living spaces during the day and sleeping spaces at night.

Plan all mechanical systems in detail during the design phase. This includes, for example, planning the ductwork layout and comparing with structural drawings to ensure duct runs are compatible with the location of load bearing beams. This ensures components, routing, and access points are accounted for early, avoiding conflicts and costly changes on site.

When cooling a single, non-isolated room, understand how load calculations work. For example, the [HVAC DC/TECA Guideline] recommends using features like door closures to thermally isolate a space. If connected spaces are not isolated, the entire area must be included in the load calculation, which often requires larger, more expensive mechanical systems.

**Benefits:** Lower costs; Passive; Manages demand



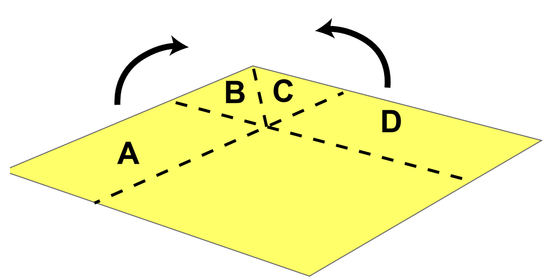
To mitigate the risk of elevated radon levels in living spaces, rough-ins for slab depressurization systems are required across B.C. These systems, which must include an air barrier system conforming to BC Building Code Subsection 9.25.3, are intended chiefly to prevent radon gas from entering living spaces. As a secondary effect, they also improve the airtightness of buildings, contributing to energy efficiency. Air barriers installed along foundation walls serve the same two purposes: retaining conditioned air and helping limit radon entry.

Vertical radon pipes must always be insulated and must be sealed wherever they penetrate the air barrier. In almost all cases, these systems have minimal effect on the overall thermal efficiency of the home.

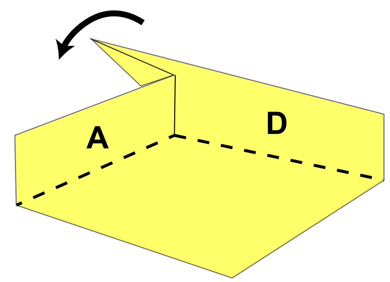
For builders or owners concerned about radon levels, ensuring the home's living space has adequate ventilation with air intakes located near the slab can provide additional peace of mind. However, builders should note that conventional ventilation on its own cannot substitute for a properly designed radon mitigation system with either passive or active ventilation through a well-sealed vertical radon pipe.

Radon testing for completed builds is always advisable, especially in areas known to have higher levels of naturally occurring radon.

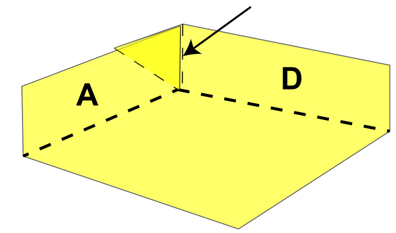
**1. Fold barrier material along dashed lines as shown, bringing faces B and C together**



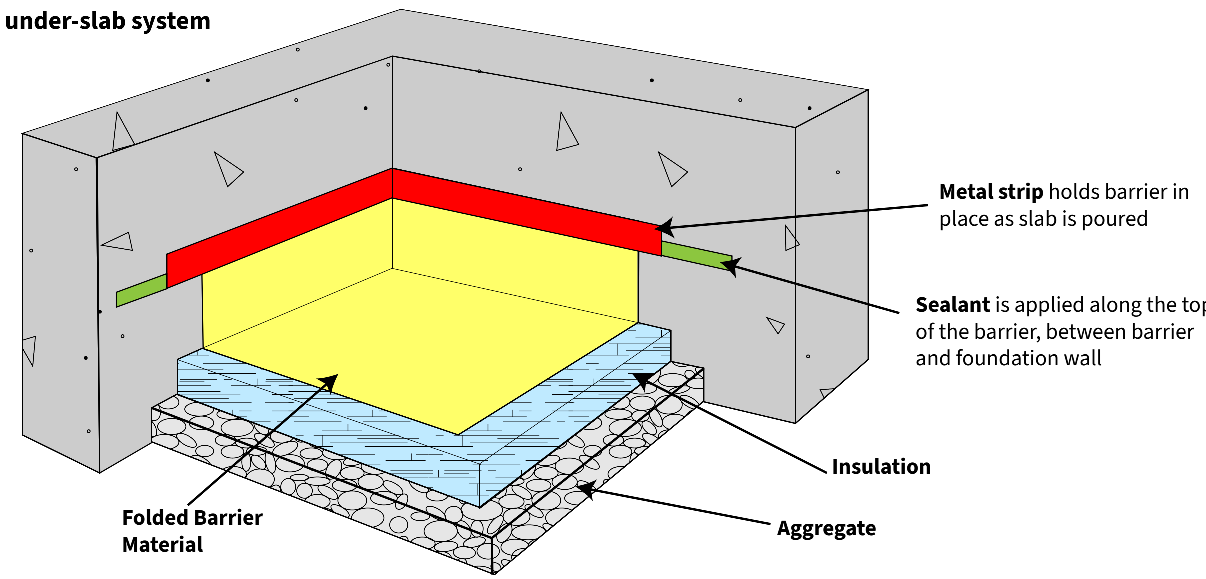

**2. Fold the combined B and C faces back behind face A**




**3. Apply sealant along the joint between faces A and D**




**4. Install along with rest of under-slab system**

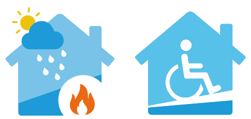



> **Detailing,** especially at material joints, around corners, and at penetrations, is essential for mitigating radon risk and may also reduce air leakage. An example of internal corner detailing is shown above.

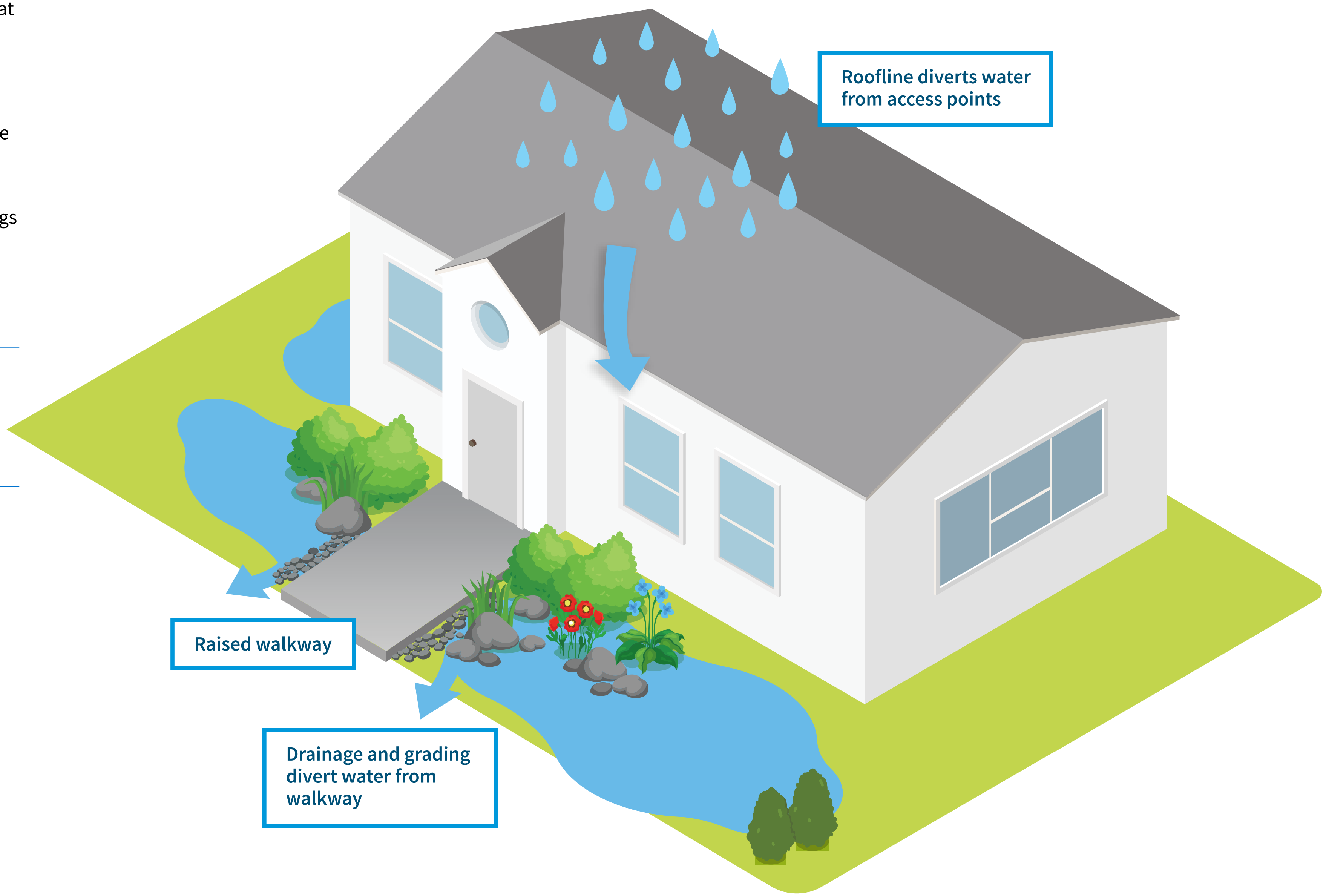
# Build for all-weather accessibility

Drainage problems that cause water ingress are a serious threat to the building envelope and longevity. Beyond that, water pooling anywhere on the property creates major accessibility challenges.

Pooling water on access pathways, ramps, or near below-grade entrances can block or prevent safe egress. This is a life-safety issue, not just a nuisance. Your site drainage plan should prioritize these key access and egress points to ensure buildings are accessible during all types of weather. Install drainage systems that keep pathways clear and usable, even during heavy rainfall or snowmelt events.



**Benefits:** Climate resilience; Accessible

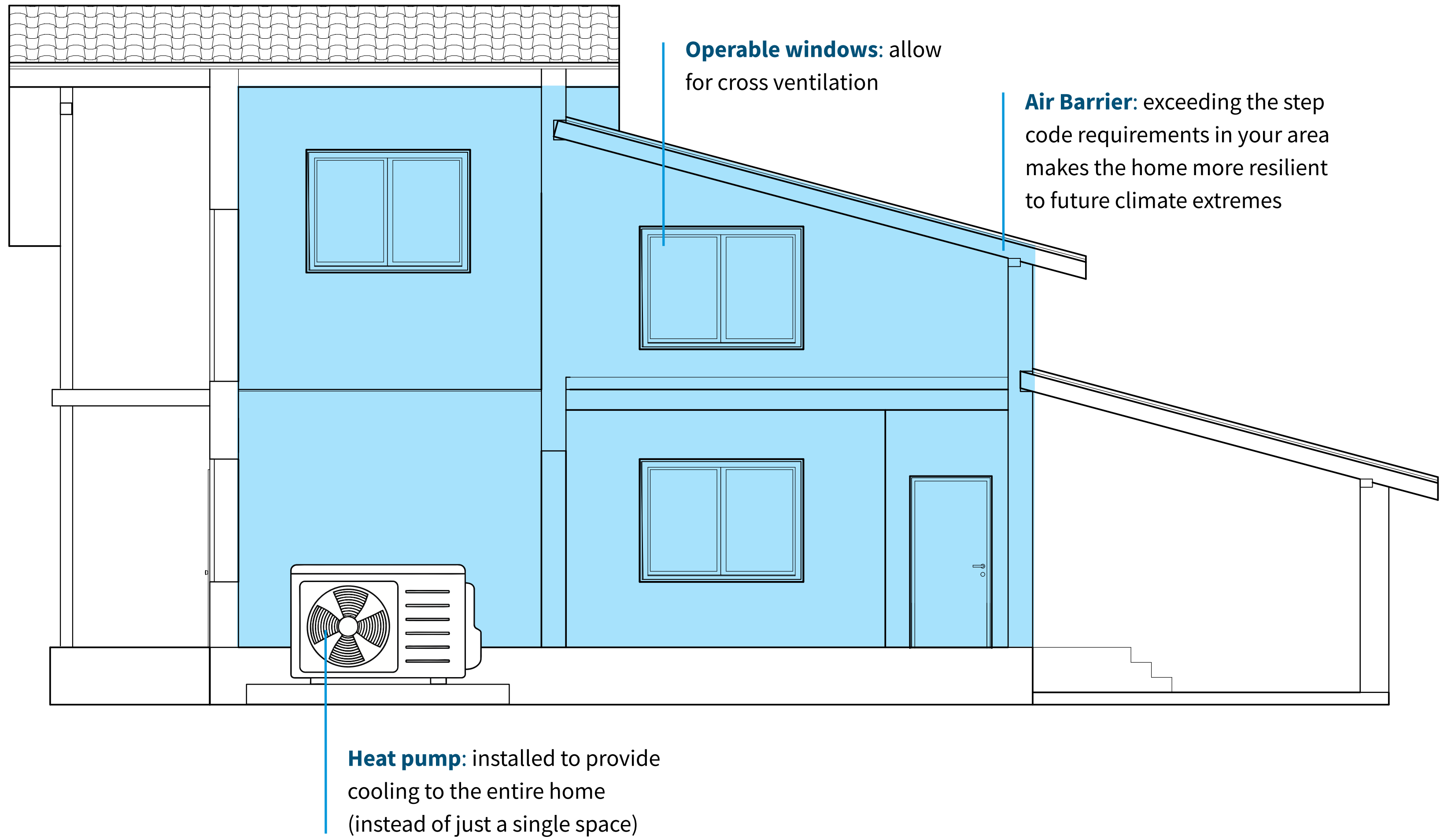


# Plan for future climate loads

Builders and design teams need to recognize that B.C.'s climate is changing toward hotter, drier summers and warmer, wetter winters. While current energy modelling relies on historical weather data, those results may not reflect the conditions homes will face in the coming decades.

To ensure long-term comfort and resilience, focus on building homes that retain comfortable indoor conditions efficiently. Going beyond local step code minimums for the building envelope provides a vital buffer against climate uncertainty. A robust, well-sealed home is the best preparation for the variable conditions homeowners will experience in the future.

For other climate threats, such as those from wildfires and increased storm severity, refer to practices in the building envelope, and mechanical equipment (HVAC) sections.



# Other design best practices

» **Design Efficient Overhangs** (Low Carbon Toolkit)
Overhangs keep sun off windows and can be an easy way to prevent overheating in summer, while allowing solar heat gains in winter. Horizontal overhangs work best on south facades, while vertical shades may be better for east/west; all need to be properly designed for effectiveness. Planning carefully can reduce the cost and minimize any conflicts with envelope details.

» **Separate ventilation (DOAS, dedicated outdoor air system) systems from heating/cooling system** (BC Energy Step Code Design Guide)
Dedicated outdoor air systems supply 100% fresh outdoor air, improving air quality and filtration. These systems can be more energy efficient because fans are sized only for outdoor air and run only when needed. Allows better distribution of outdoor air to rooms as needed. Many heat recovery options are available.

» **Use landscaping as shading** (FireSmart BC)
Trees can provide shade, although some constitute a fire risk. Deciduous trees are a better choice for shading near homes.

» **Incorporate elements that build community into the design** (City of North Vancouver)
For multi-unit buildings, meeting spaces, common areas, and other spaces which optimize interaction between neighbours can help to establish critical social networks during heat or storm events. They can also serve as cooling or clean-air refuges during extreme events.

» **Use low VOC materials** (BuildingScience.org)
VOCs are chemicals found in various products, including paints, adhesives, and flooring materials, which can off-gas and negatively impact indoor air quality. By opting for low-VOC materials, builders help prevent health issues such as headaches, dizziness, and respiratory irritation, ensuring a healthier living environment for occupants.

» **Minimize gutter lengths for fire resistance** (FireSmart BC)
Simple roof shapes are not only easy to build, they also minimize the amount of gutters which trap combustible debris and provide a potential foothold for embers to spread from wildfire. Gutters should be covered with guards where possible.

» **Be Solar Ready** (NRCAN)
Orient roofs for maximum solar exposure and consider how solar panels may need to interface with the building wiring. Ensure structural design is sufficient, or modifiable to support roof-mounted panels.

**Builder Tip:** Work with your designer or architect to incorporate community elements. In this project, homes are arranged around a shared central courtyard that enhances light, circulation, and the potential for neighbourly connection.

*Image: Nick Bray Architecture, Western Wonder*

# Best practices for building envelope


*Fernwood Victoria Retrofit: Builder Frontera Homes Ltd*

The successful execution of high performance construction relies on the quality of the building envelope's construction. A well-built envelope is essential to retaining the comfortable interior air and keeping external air (which can be too hot, cold, humid, or dry) from leaking in through unwanted places. Fresh air is instead brought in deliberately through ERVs/HRVs, fresh air intakes, or through passive measures like operable windows.

An improved building envelope also acts as a crucial measure of resilience. By significantly slowing the rate of heat loss or gain, a high performance envelope provides a passive defense during utility failures and saves energy, cost and emissions during normal operations.

For instance, during a winter power failure, the slow rate of heat loss means the building temperature drops much slower than a conventional home, extending the habitable period. Similarly, in summer, the insulation can keep cold air in. This improved envelope performance may reduce or eliminate the need for expensive backup power systems, unless the power failures in the region are known to be prolonged.

Practices in this section will teach how to achieve these performance and resilience benefits, covering the construction or installation of key elements of the building envelope, including the air barrier, windows and insulation.

> **Builder Tip:** Because Air Changes per Hour (ACH) is a ratio of volume, small volume homes are at a disadvantage. To make the code fair for all building types, Normalized Leakage Area (NLA) and Normalized Leakage Rate (NLR) are ratios of surface area, which can be more appropriate metrics for smaller homes.

## IN THIS SECTION

**Treat exposed floors as exterior envelope**

**Consider the relationship between insulation and moisture**

**Insulate below grade properly**

**Avoid sealant mistakes**

**Use the envelope to protect against fire and water**

**Pick the best envelope design for the job**

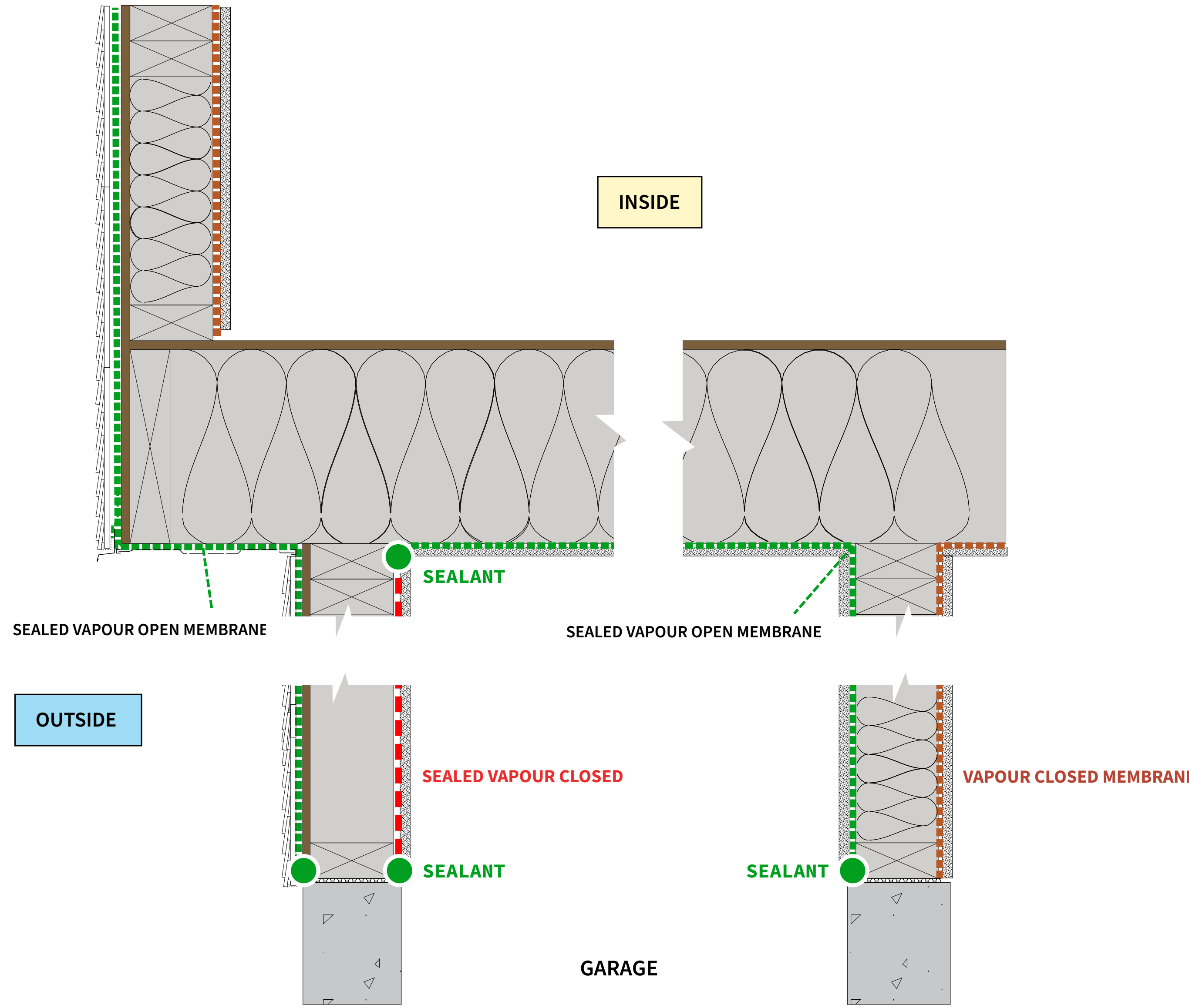
OTHER VALUABLE **RESOURCES**

# Treat exposed floors as exterior envelope

Builders should recognize that exposed floors—specifically those located over cantilevers or forming the ceiling of an unconditioned space like a garage—must be treated as a key part of the thermal envelope. These floor assemblies require the same air barrier and insulation standards as an exterior wall. Because these design elements feature complex transitions and many potential failure points, they require particularly careful consideration during construction to seal and insulate effectively.

The same can be said for walls adjacent to unconditioned spaces, such as attached garages. These must be insulated and sealed in the same way as exterior walls.

**Benefits:**
Manages demand



# Consider the relationship between insulation and moisture

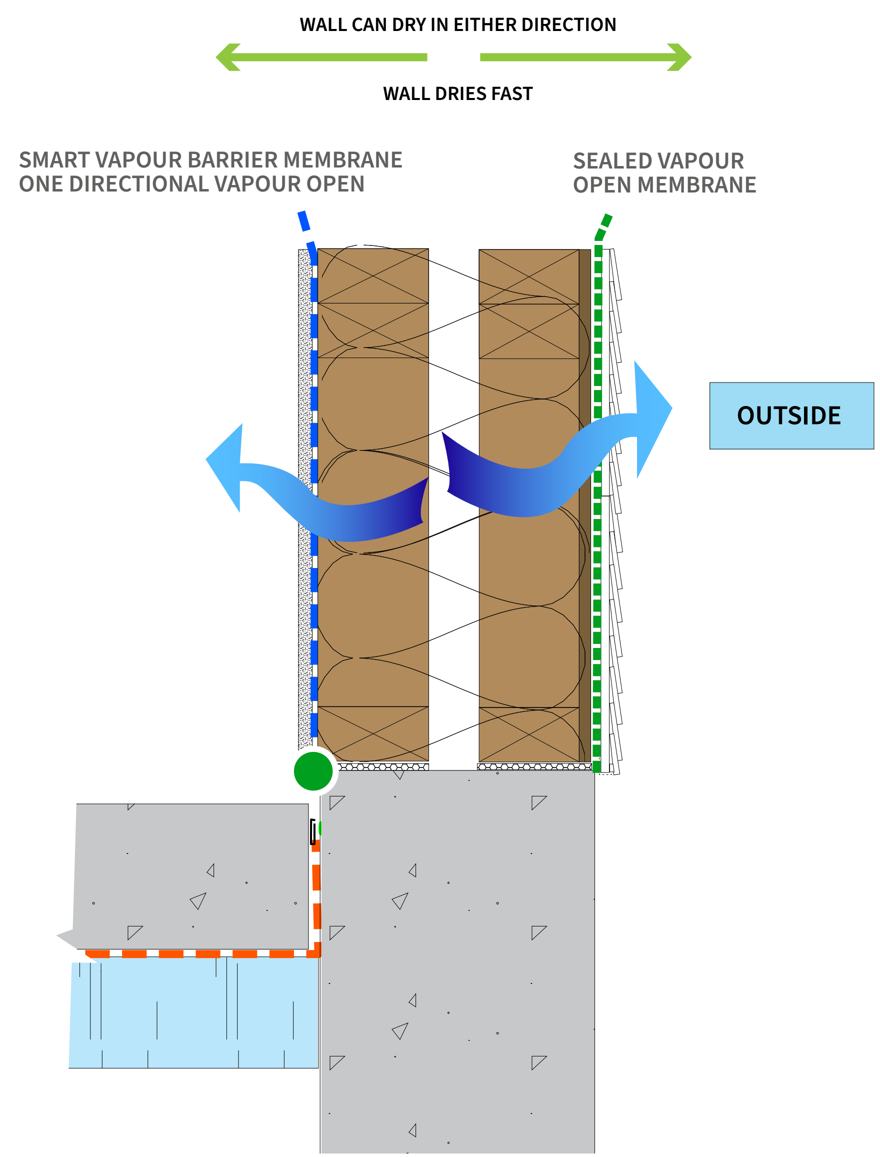
When constructing deep wall cavities with significant insulation thickness, it is essential that a good quality, continuous air and moisture barrier are employed to reduce the risk of potential moisture issues within the assembly. Even with good practices, builders should note that air and moisture barriers are not immune from damage over time. Without careful attention paid to how moisture can escape from these assemblies, the risk of mold and rot can be high.

Similar caution should be applied when using low-permeance insulation materials such as Extruded Polystyrene (XPS) as external insulation. If this system is combined with an interior vapour/air barrier, moisture that penetrates the wall cavity may be unable to escape.

Builders should always remember that the home functions as an integrated system, where all components—from the foundation to the roof, and the air barrier to the mechanical systems—must work in tandem to deliver both energy performance and long-term resilience.

> *"At Frontera Homes, our experience building Passive House and Net Zero homes has reinforced that high performance walls must carefully manage moisture while still allowing assemblies to dry in a controlled way. By prioritizing bulk water control and airtightness and pairing those strategies with climate-appropriate vapour control, we ensure walls can dry safely to the interior or exterior as intended."*
>
> *- Taylor McCarthy, Owner, Frontera Homes Ltd.*

**Benefits:** Durability; Passive



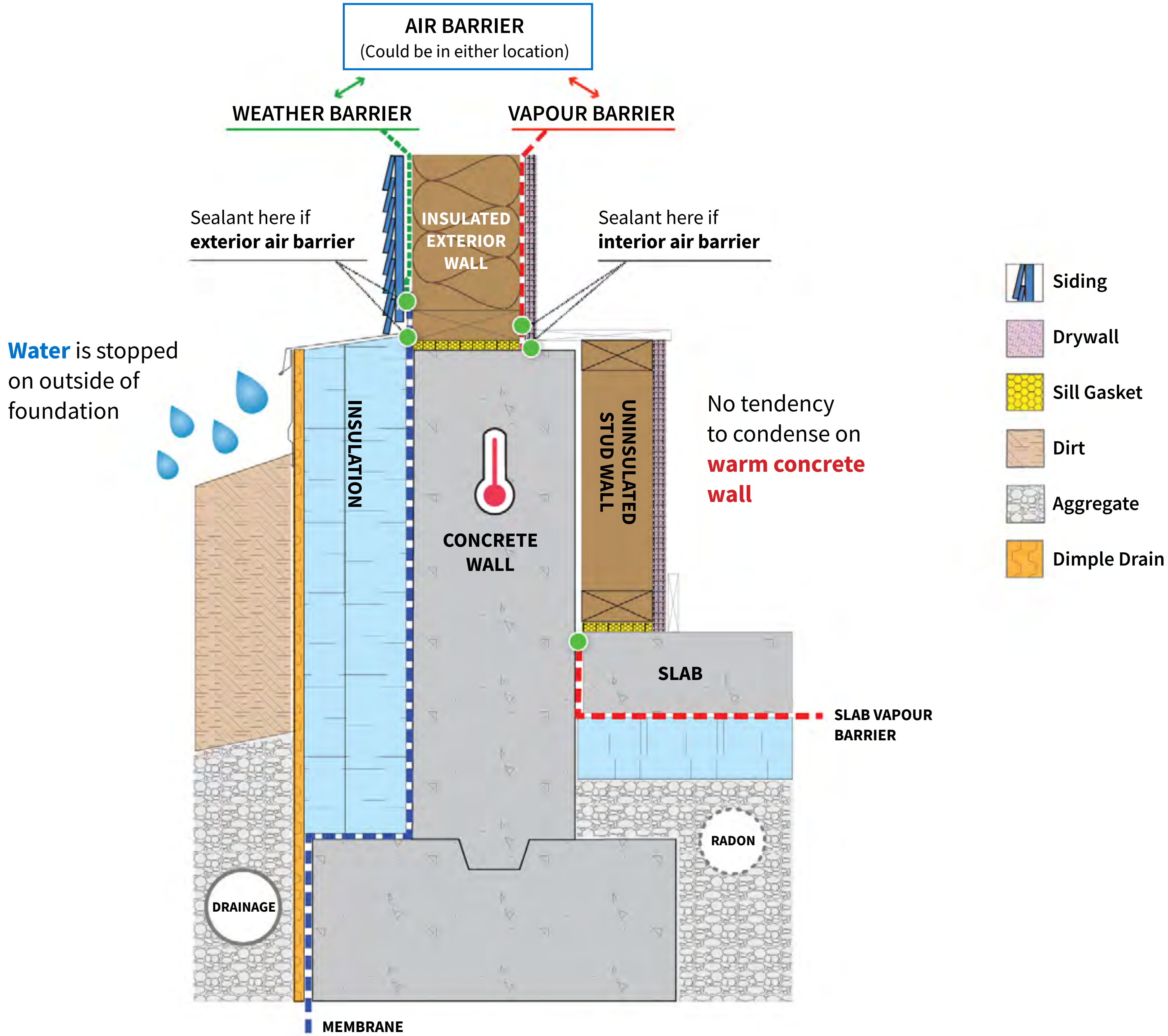
# Insulate below grade properly

Foundation walls need special attention because they sit below grade where moisture is a constant concern. Wet soil traps water against the exterior of the foundation, and since concrete is permeable, water can slowly seep through. The amount of water may seem small, but it builds over time.

When framing, insulation and a vapour barrier are located *inside* the foundation wall, the concrete stays cool. Water vapour or liquid water can enter the wall cavity and can get trapped with limited drying potential given the installation of an internal vapour barrier. This soaks insulation, reduces its effectiveness, and can lead to mould and the familiar musty basement smell.

The better approach is to apply a moisture barrier and insulation on the outside of the foundation wall. The moisture barrier adds protection against water penetration, while the exterior insulation keeps the foundation wall warm and prevents condensation. This strategy also adds thermal mass, helping maintain comfortable indoor temperatures even as the outside temperature swings.

**Benefits:** Durability; Climate resilience



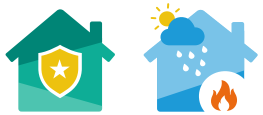
# Avoid sealant mistakes

A building is never static. Materials expand and contract with changes in temperature and moisture, creating gaps and potential air leaks in the structure. Sealants are used to fill these gaps, but improper selection or application of sealants can cause them to fail prematurely. Over time, this movement can compromise the airtightness of the envelope, increasing energy costs and reducing comfort for the occupants.

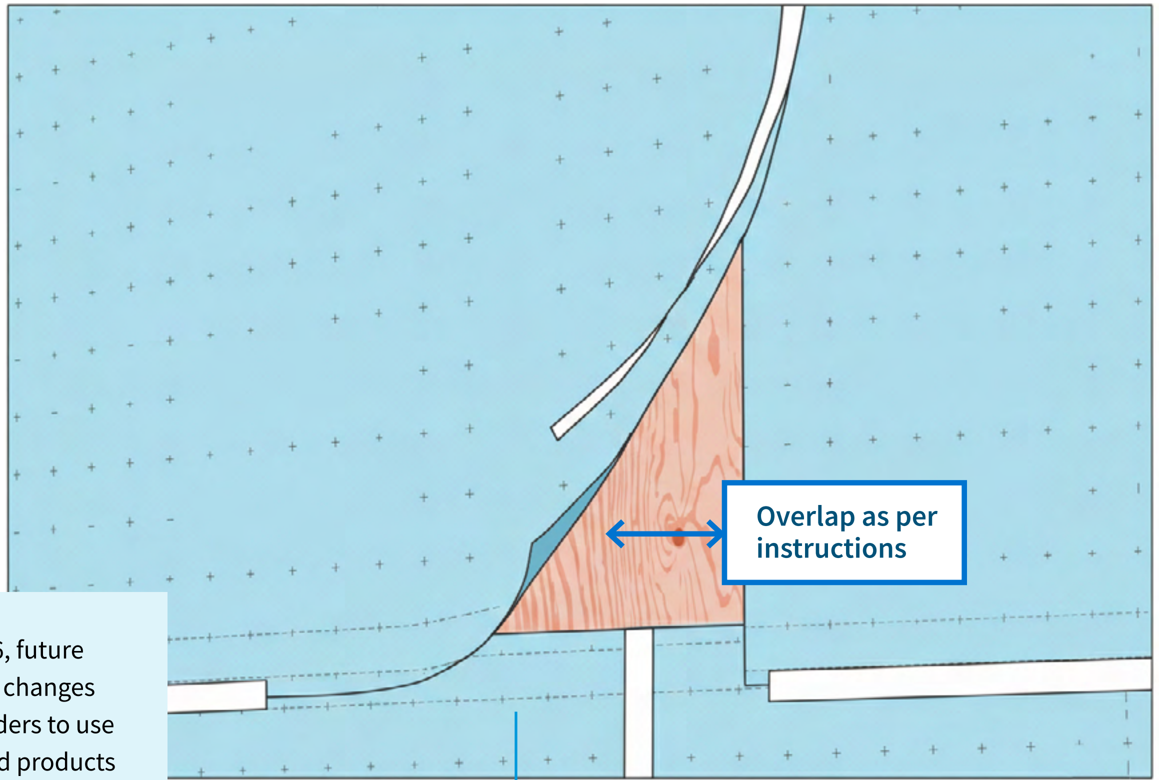
To lock in high performance over the long term, pay close attention to sealing products at joints and around components made of different materials and follow best practices and manufacturers' requirements for selection and installation of sealants.

Key practices:

- Sealants should be **installed according to the manufacturer's specifications**, with special attention being paid to dry application and temperature requirements
- New **products which are not explicitly covered by the code require consultation** with the Authority Having Jurisdiction to ensure their suitability
- **Rigid materials such as spray foam or poly tape can crack or separate** at joints where materials move differently**.** Avoid using these sealants in junctions involving different materials. For example, poly tape works well to seal two sheets of poly, but should not be used to seal poly to a wood stud that will shift over time.



**Benefits:** Durability; Climate resilience



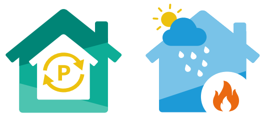

As of early 2026, future proposed code changes may allow builders to use CCMC evaluated products to be deemed acceptable solutions

**Manufacturers** often provide guidance on how to use their products. Refer to instructions like the one above to learn how to apply products correctly every time.

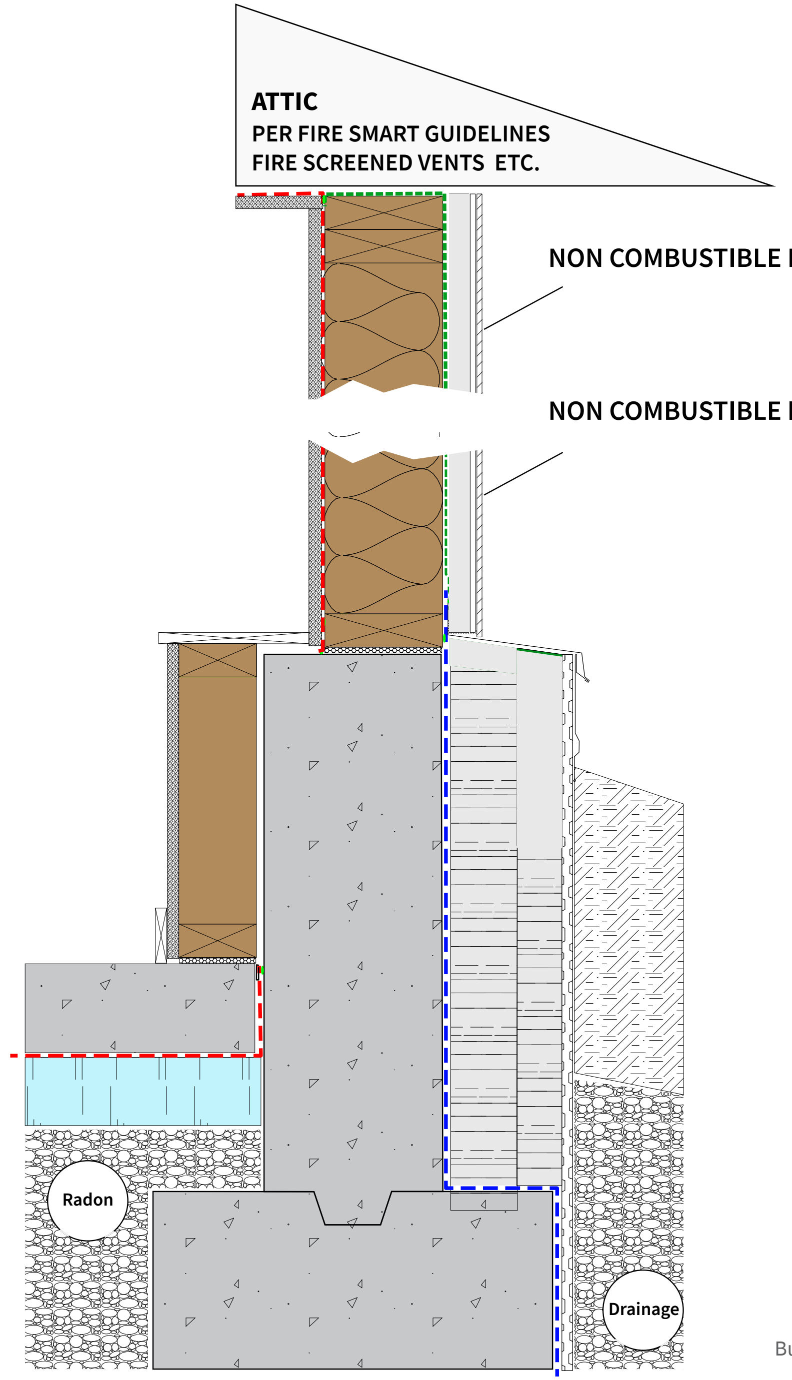
# Use the envelope to protect against fire and water

The building envelope is the primary defense against both common and extreme climate hazards. Well-sealed and well-insulated buildings are designed to handle adverse events: during an extreme heat wave or a power failure, a well-sealed and insulated envelope ensures that the interior temperature changes slowly, keeping the building comfortable or habitable for longer.

Beyond thermal resilience, the envelope is the main point of defense against heavy rainfall events (preventing water ingress) and interface fires. Builders should refer to the [FireSmart guidelines] and local risk maps for the specific region. These resources provide essential, detailed guidance on how to use envelope protection, material selection, and landscaping to mitigate wildfire risk.



**Benefits:** Passive Design; Climate resilience



# Pick the best envelope design for the job

Builders benefit from being familiar with multiple wall assemblies and air barrier strategies. Knowing the advantages and drawbacks of designs—such as double-stud, external insulation systems, and modified conventional wall designs — provides the flexibility necessary to offer the best, most cost-effective solution for a specific client or project site.

Likewise, there is no single "best" air barrier material; the optimal choice depends on the project's complexity, cost, and required speed. Builders must understand the strengths and weaknesses of the various air barrier methods.

- **Adhered Membranes (Peel-and-Stick)** offer high seal integrity. Some require meticulous surface preparation, but others have no need for primers and are easy to install.
- **Loose-Laid Membranes (Taped)** are common and familiar to install, but their long-term effectiveness relies entirely on the quality and proper application of the seam-sealing tape
- **Liquid-Applied Membranes** provide a monolithic seal that is effective at complex junctions, but may require specialized application equipment and specific curing conditions. Special attention is also required to prepare joints in the substrate. These are often not the best choice for wood-framed construction.

**Benefits:**
Durability

**This sample matrix** shows how different wall assemblies might be evaluated across project priorities. Your actual checklist will vary by project.

## EXAMPLE BUILDER ENVELOPE EVALUATION

| | DOUBLE STUD WITH SERVICE CAVITY | SINGLE STUD, INTERIOR INSULATION | SINGLE STUD, EXTERIOR INSULATION |
|---|---|---|---|
| Crew Experience | ✗ | ✓ | ✓ |
| Cost | ✗ | ✓ | ✓ |
| Project Goals | ✓ | ✗ | ✓ |
| Building Climate | ✓ | ✓ | ✓ |
| **BEST ENVELOPE?** | ✗ | ✗ | ✓ |

# Other building envelope best practices

» **Choose light colored reflective roofing or cladding** (BC Energy Step Code Guide Supplemental)

High albedo/ reflective roofs, and to a lesser extent, wall cladding, help to reduce local heat island effect and can help reduce overheating risks. At a minimum, consider roofing materials with higher solar reflectance than conventional dark asphalt shingles, especially where overheating risk is a concern. Note that cladding is not modeled in HOT2000, but that light colors will help reduce absorption of heat.

---

» **Choose low embodied carbon materials** (Carbon Leadership Forum Low Carbon Solutions for Multi-Unit Residential Buildings)

New construction is the one time to impact the embodied carbon of much of the building. During retrofits and renovations, re-using materials can reduce embodied carbon as well.

---

» **Select window coatings to reduce glazing solar heat gain coefficient (SHGC)** (BC Energy Step Code Guide Supplemental)

Higher SHGC reduces TEDI but can also be a problem in high heat / sun areas, due to increased risk of overheating in warm seasons. This risk can be somewhat mitigated through overhangs or exterior blinds, depending on window orientation.

Additionally, certain aftermarket coatings can void warranties, so it is best to choose windows which have the coating applied during manufacturing.

---

» **Ensure effective drainage on site and around foundation** (Builder Guide to Site and Foundation Drainage)

BC Housing's Builder Guide to Site and Foundation Drainage - Best Practices for Part 9 Houses, provides best practices and design and construction considerations for site and foundation drainage as well as building enclosure systems. This resource teaches designers, construction industry professionals and others how to go beyond to ensure resilient site and foundation drainage.

*High performance window installation, exterior insulated Larson truss wall, Cowichan Valley*

# Best practices for mechanical equipment (HVAC)

The practices outlined in this section cover the selection, proper installation, and crucial evaluation of HVAC equipment to ensure maximum building performance. These strategies also detail how builders can best engage with mechanical contractors, who are the experts on these complex systems.

Several practices in this section relate to work commonly carried out by mechanical contractors. Builders should still verify that these practices are being followed, since HVAC performance directly affects the overall success of the home.

Builders should strive to verify with the mechanical equipment installer that the practices below are being followed.

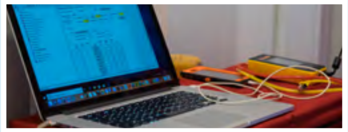
It is important to note: while the industry is still transitioning to new, lower Global Warming Potential (GWP) refrigerant gases, equipment is readily available and being installed successfully across all climate zones, including areas with extreme temperature swings. Continuing to install high-efficiency heat pumps remains the best pathway for achieving both environmental and economic performance goals.

## IN THIS SECTION

Run the numbers on fuel-based vs. electric systems

Make your systems easy to upgrade and service

Size ducts using established standards



Update the F280 for real conditions

Use the system's set point

Look for indicators of quality in mechanical contractors

Plan ahead for the next trade

Verify and tune your heat pumps

Set the hot water temperature correctly

Follow manufacturer checklists

OTHER VALUABLE **RESOURCES**

# Run the numbers on fuel-based vs. electric systems

Choosing the best system for a home requires a thorough analysis that extends beyond simple material cost. Builders should weigh the following key factors to make an economically and environmentally sound decision:

- **Initial system cost:** The upfront capital expense for purchasing and installing the equipment
- **System efficiency (COP):** The Coefficient of Performance, which reflects how efficiently the system converts energy into heating or cooling
- **Cost of energy:** The current and projected rate for electricity versus natural gas in the service area
- **Cost of service:** The hookup and connection charges required by the utility providers. A gas furnace makes less sense if it would be the only gas appliance in the home.
- **Maintenance and replacement costs:** Certain systems may require more frequent or more expensive service. Additionally, some systems last longer than others.
- **Local climate:** The specific temperature extremes and humidity levels that dictate the system's performance requirements
- **Bylaw requirements:** Mandates for Zero Carbon Step Code (ZCSC) compliance in the municipality, which may favor electric systems

Each of these factors should be carefully evaluated to select the system that delivers the best long-term value and performance.

**Benefits:**
Affordable

This **sample table** shows how costs might add up for different systems. Your costs will vary (in some cases substantially) by project.

| | GAS FURNACE (PRIMARY) + MINI SPLIT (SECONDARY COOLING) | ELECTRIC HEAT PUMP (PRIMARY) +ELECTRIC BASEBOARD (SUPPLEMENTARY) |
|---|---|---|
| Annual Energy Cost | $1,200 | $600 |
| Initial Primary System Cost | $7,000 | $15,000 |
| Secondary Cooling System Cost | $4,000 | $0 |
| Supplementary Heating Cost | $0 | $3,000 |
| Additional Utility Hookup Fees | Large Variation in Fees | $0 |
| Annual Maintenance Cost | $300 | $200 |
| Additional Recurring Meter Fees | $50 (if no other gas applicanes) | $0 |
| Rebates | $0 | $5,000 with eligible install |

**Electrical grid capacity:** Utility providers routinely conduct exercises to estimate future energy demand and are aware of the increase in electrical loads that is planned for the building sector. BC Hydro has also recently updated their **service extension policy**, to deliver fairer hookup rates for builders in areas undergoing rapid development. Consulting with BC Hydro (or your local service provider) early in the design process is highly recommended to confirm service availability and understand any associated costs for new or upgraded connections.

# Make your systems easy to upgrade and service

Climate loads are changing and they will continue to shift over the next few decades. Future systems may need more cooling capacity, so plan ahead. Leave enough space around mechanical systems to allow for easy upgrades later. For furnaces or heat pumps, work with mechanical contractors to ensure ducts are sized appropriately.

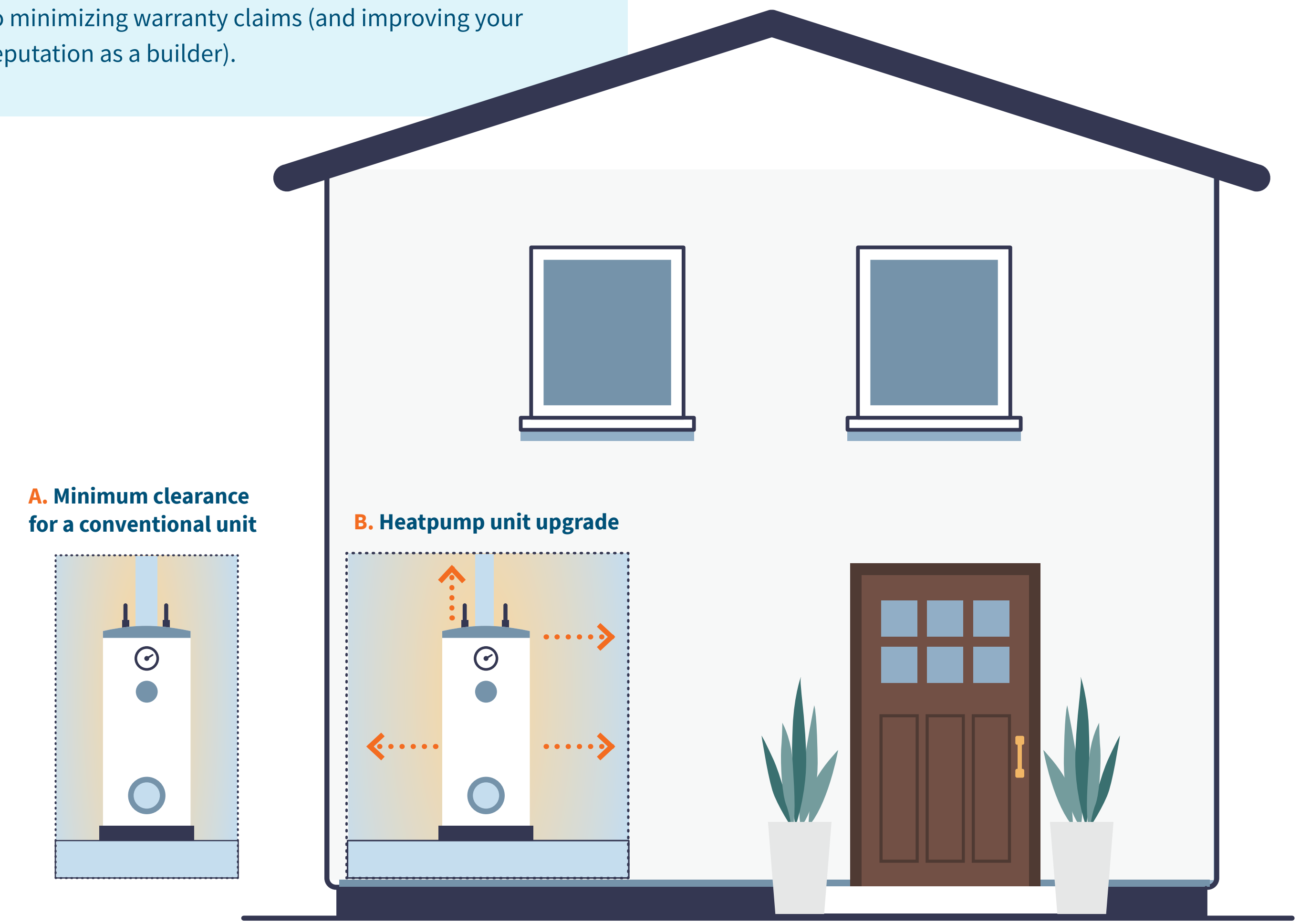
Consider the potential of different types of equipment being installed in the future. For example, gas boilers and electric tanks require similar volumes of space but in different proportions. Planning for this now prevents major rework later.

Forward planning also improves serviceability. Leaving ample room makes routine maintenance and future repairs easier.

Finally, coordinate with mechanical contractors to give homeowners the option to upgrade to higher-rated filters. This is essential during wildfire smoke or poor air quality events. Clearly communicate the maximum allowable filter tightness (or MERV rating) during the final handover.

**Benefits:** Durability; Climate resilience

**Builder Tip:** Set up automatic maintenance reminders. Particularly with modern equipment and/or first-time homeowners, some brief reminders can go a long way to minimizing warranty claims (and improving your reputation as a builder).



# Size ducts using established standards

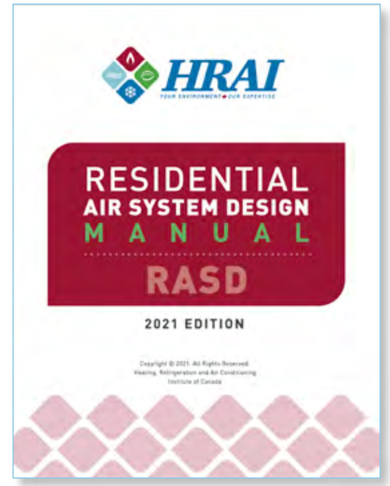
Proper planning for duct sizing and routing is essential for an efficient and functional HVAC system. Failure to plan adequately can result in duct runs that are unnecessarily long or have lots of corners, which makes them less efficient and more costly to install. Poor routing can also lead to unsightly bulkheads passing through visible or critical areas of the home.

Duct sizing must be done according to proper standards and calculated, not estimated using rules of thumb. Builders should ensure that all ductwork is adequately sized to meet the heat pump's required air flow and the available static pressure of the unit. The ventilation duct system design should follow the CSA F326 standard. Heating duct systems should follow other applicable standards, such as [this zoning duct design guide from Natural Resources Canada.]

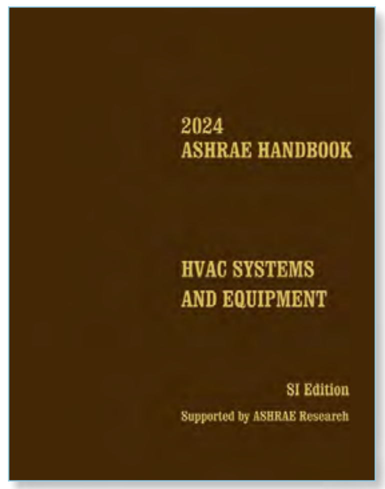
Builders should be aware that the CSA F280 is not interchangeable with the load calculations generated by modeling tools like HOT2000. While HOT2000 calculates whole-home heating and cooling loads, it does not provide the loading requirement for each room in the home; an essential piece of information for duct sizing. Thus the CSA F280 is required in addition to the HOT2000 report.

**Benefits:**
Manages demand

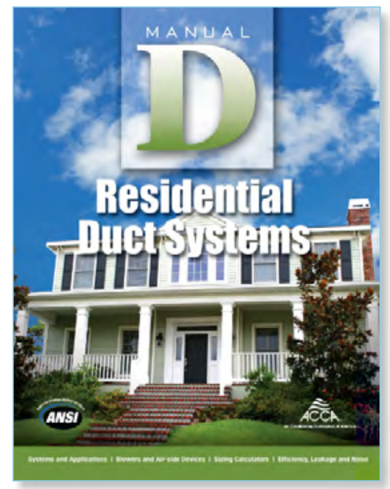

LINK TO **REPORT**




LINK TO **REPORT**




LINK TO **REPORT**




LINK TO **REPORT**

*"After building multiple high performance homes over the course of the last ten years, we can say with certainty that diligence in selecting appropriate mechanical designers, suppliers and tradespeople can assure success for client comfort and operational budget. If your tradespeople view your home build as just another house, rather than observing the assemblies and components that are unique to that specific project, get new ones – do not accept lazy "rule-of-thumb" sizing methods."*

*-Shay Bulmer, Owner, Northern Homecraft Ltd.*

# Update the F280 for real conditions

Builders should treat the mid-construction air tightness test as a crucial checkpoint regardless of whether or not it is mandatory in their area. The mid-construction test not only provides an opportunity to fix problems before they become expensive, it also allows builders to revisit the initial HVAC design and revise it if necessary by updating the original heating and cooling load calculations.

This step uses the actual measured air tightness of the partially completed home to ensure that the original HVAC design still meets the performance requirements of the final structure. This prevents oversizing or undersizing equipment and validates the initial design assumptions.

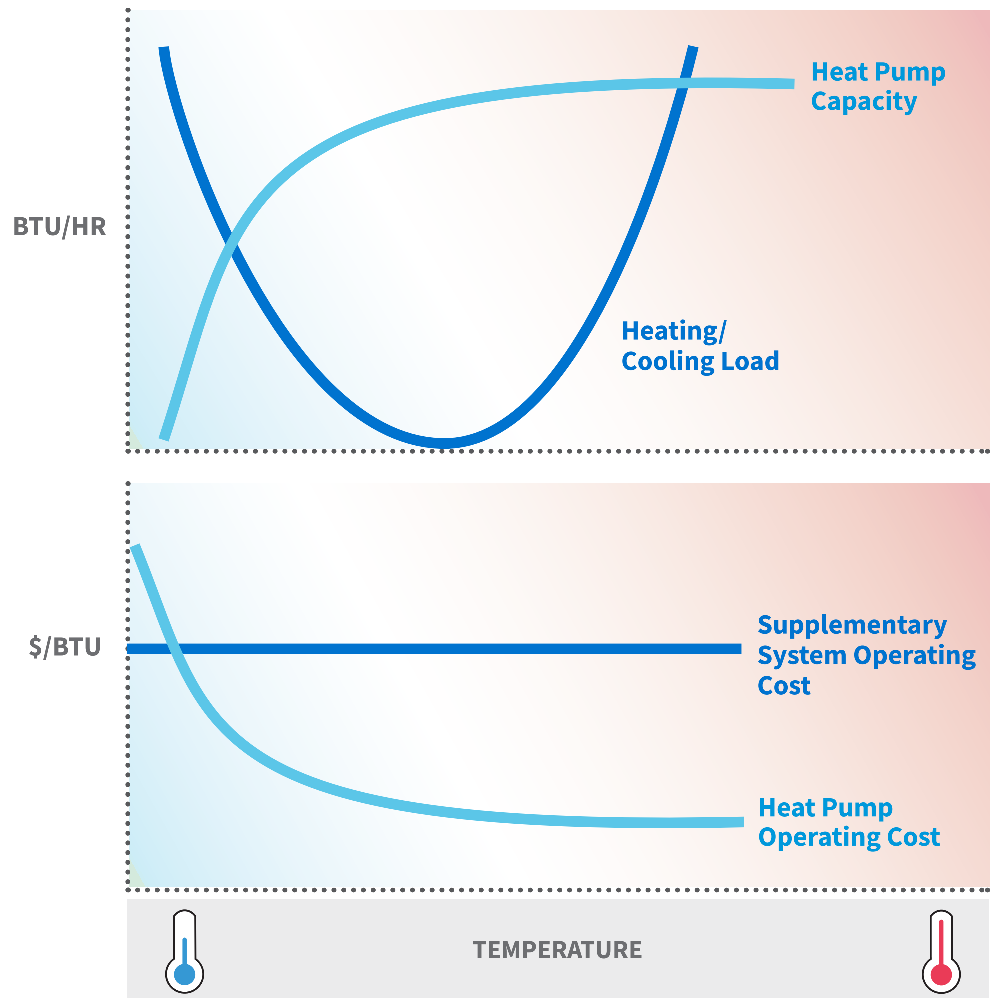
**Benefits:**
Lower costs

# Use the system’s set point

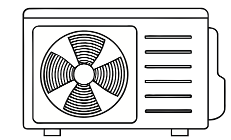
When commissioning a heat pump, the settings must adhere to the BC Building code and manufacturer’s specified set points for that system. These rules must take priority over advice from Authorities Having Jurisdiction (AHJs) or rebate programs. Using set points that are very different from the initial factory set points can hurt the system’s efficiency and shorten its lifespan.

It is important to make sure the controls comply with code. Usually, this requires that the heat pump works at maximum capacity before the supplemental heating system (such as electric resistance coils or natural gas, in the case of dual fuel systems) turns on. Exactly when this switch happens depends on the product and the local weather. This makes it hard to create a single standard for energy tests, but following the equipment's intended design is the best way to save energy.

**Benefits:**
Affordable




***When set properly**, a heat pump should work at maximum capacity when temperatures are either very high or very low. Once the heat pump has reached maximum heating capacity at low temperatures, a supplementary system can be activated to supply any additional heating needed.*



The supplementary system should activate when:

***The heat pump system cannot supply sufficient heating load***

***OR***

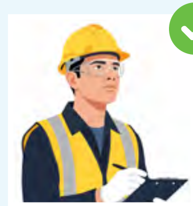
***The heat pump system is no longer the most cost-effective way to supply heat***

# Look for indicators of quality in mechanical contractors

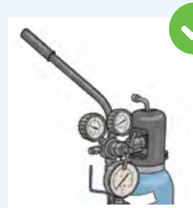
Builders cannot be experts in every area of home construction. While you need a basic knowledge of energy modeling, bylaws, and trends, it is unrealistic to master every detail. Mechanical systems are one area where builders must rely on specialists, but they can still check for signs of quality.

**Benefits:** Affordable; Durability

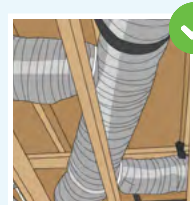
**Key indicators to look for:**



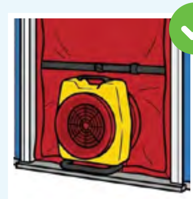
**Ask for EA reports, including the CSAF280.** These provide the data needed to properly size equipment and ducting. Contractors who don't ask may be using outdated rules of thumb that don't work for high performance homes.



**Verify equipment on site**. Builders do not need to know how to do a nitrogen pressure test, but if the contractor doesn't bring a nitrogen bottle when commissioning a heat pump, they are skipping a critical step. This is a large and obvious piece of equipment, so it's an easy check.



**Inspect duct sealings and insulation**. Builders can visually confirm whether ducts are sealed neatly and insulated properly once installation begins.



**Ask about system testing**. Contractors should test the system after installation to ensure optimal performance. They may not provide formal documentation, but they should be able to explain their commissioning process before and after the build.


**Check for certification**. TECA, HRAI and HPCN training covers mechanical system design and installation. In some cases, certification is required for heat pump rebates. Manufacturer training is another sign that a contractor takes their role seriously.

# Plan ahead for the next trade

To speed up builds and protect a home from damage, builders should consider design features and construction sequencing that give deliberate consideration to the work trades are doing. For example, including a framed opening specifically for pipes, wires, and other mechanical penetrations can make it much easier to install and seal things like heat pump lines. By planning ahead, you keep the home's air seal tight and save time on the job site.

**Benefits:**
Lower costs

An example HRV rough-in. A mechanical installer uses a tin plate with 4 holes, making the insulation contractor's job easier.

# Verify and tune your heat pumps

Existing standards, such as CSA Standard C273.5-11, provide a reference for installation of air source heat pumps. Although this standard is not a prescriptive requirement within the current building code, builders should be aware of its use as a reference tool and should also be aware that proper commissioning is essential for optimal performance.

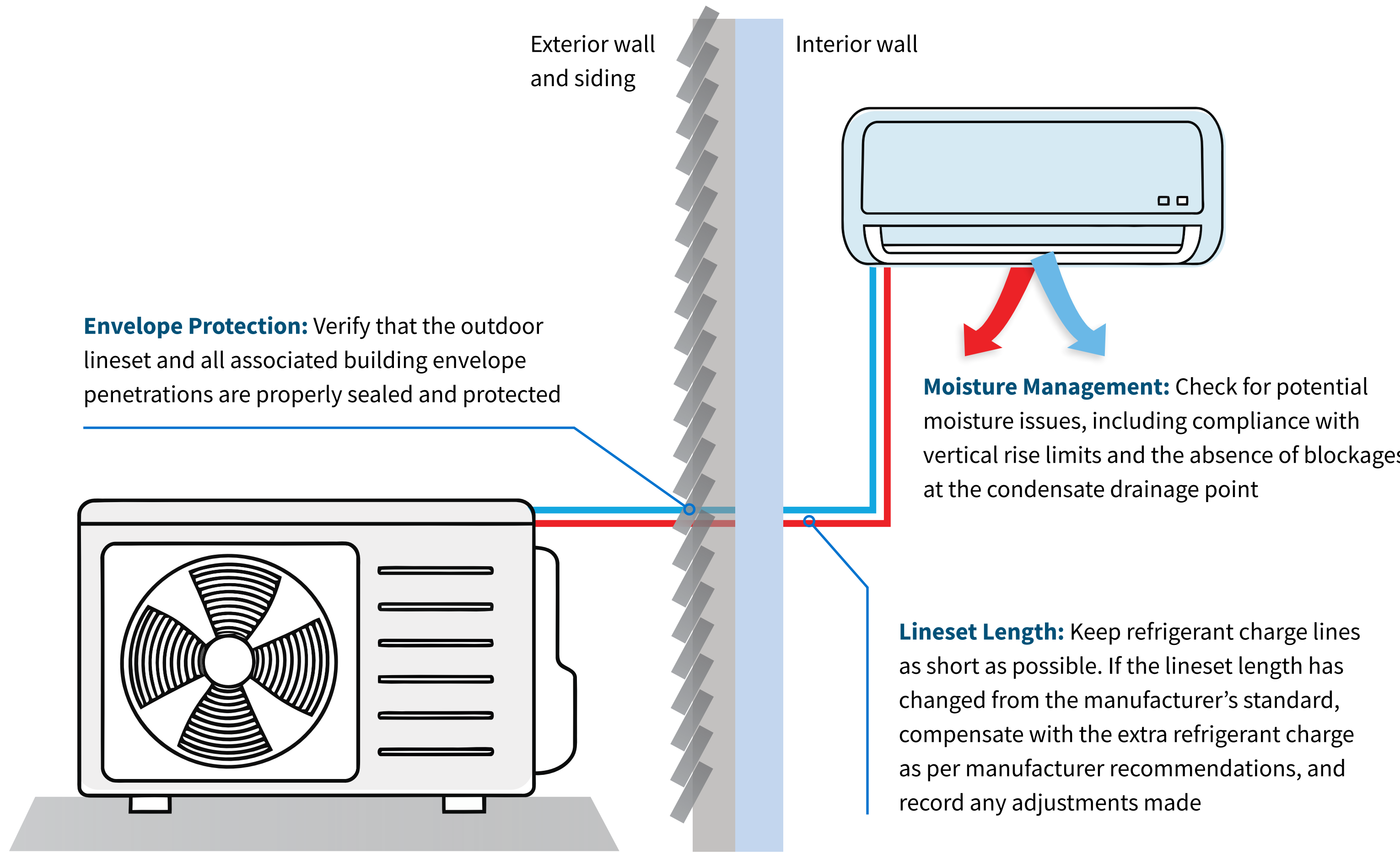
To ensure quality and performance, the following checks should be completed and documented:

**System Metrics:** All measured metrics must meet the manufacturer's specifications.

Verify the following:

- Refrigerant charge and confirm there are no leaks.
- Airflow rates across the indoor coil
- Correct power inputs
- Thermostat operation and control logic
- Acoustics: Check and record the noise levels both inside and outside, in all adjacent rooms, before and after the system is fully operational

**Benefits:** Affordable; Durability

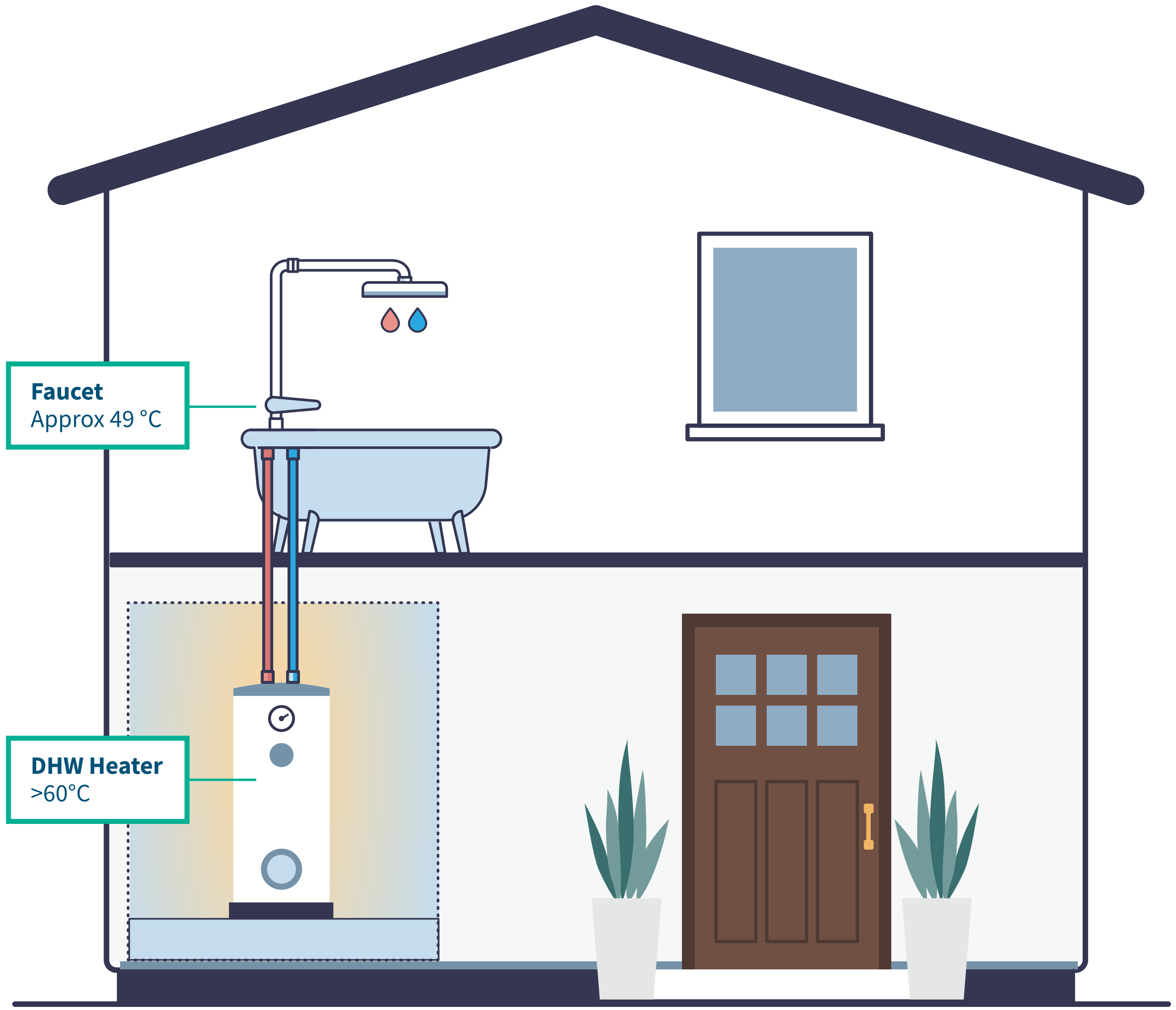


# Set the hot water temperature correctly

Builders must ensure that the design and installation of the Domestic Hot Water (DHW) system adheres to critical safety standards. The hot water must be stored at a minimum of 60°C within the tank or heater to actively prevent the growth of bacteria.

Simultaneously, builders should be aware that increasing the storage temperature substantially beyond this point introduces unnecessary energy consumption and may also compound the risk of scalding injuries at the tap. To prevent such injuries, water must be supplied at a lower, controlled temperature (typically 49°C or 120°F) to all fixtures. This function is typically handled by a certified tempering or mixing valve located close to the water heater.

**Benefits:**
Lower costs



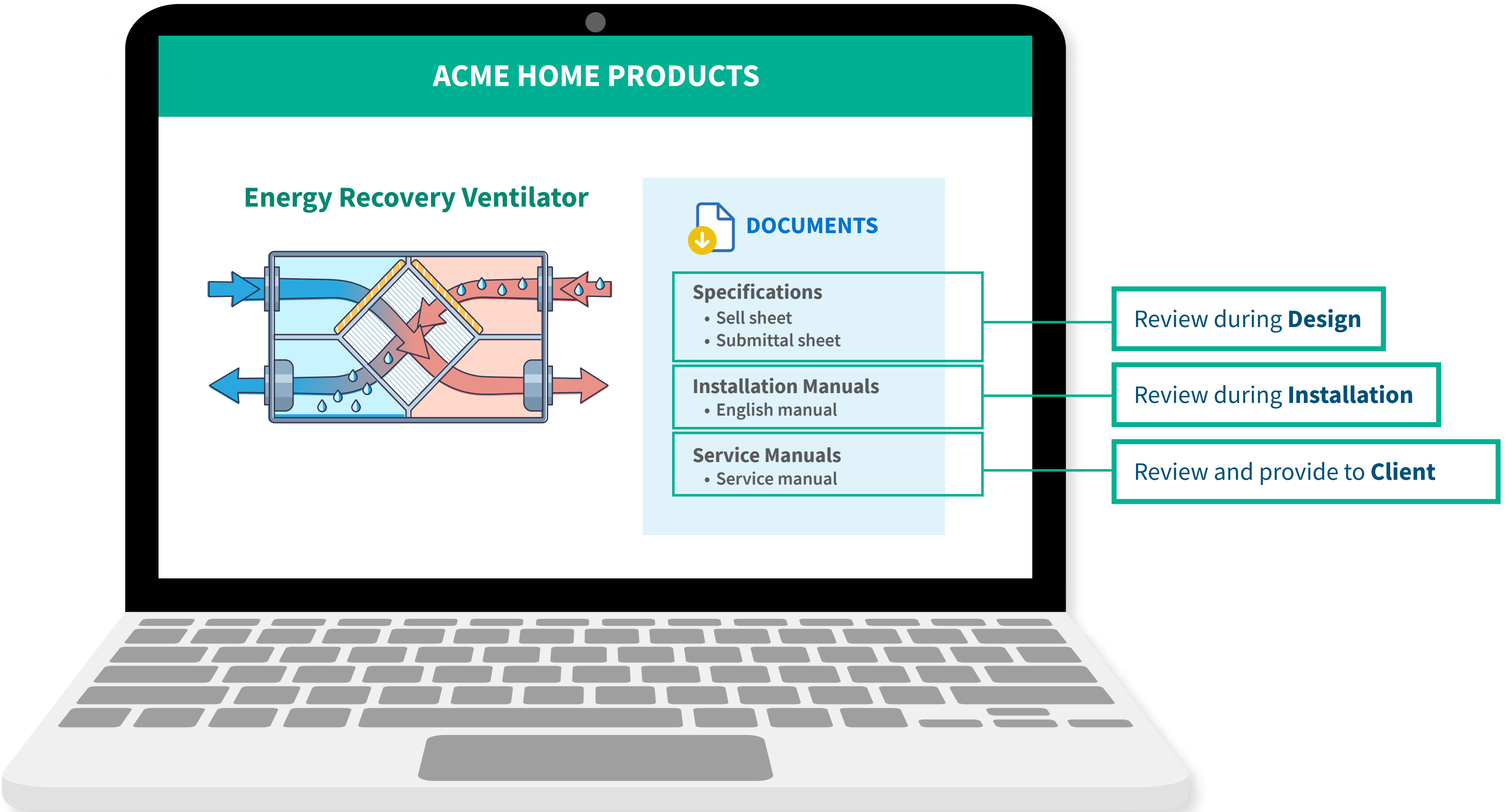
# Follow manufacturer checklists

Successful commissioning and long-term performance depend on adherence to established procedures. Always read and follow the manufacturer's specific instructions for the installation, charging, and balancing of all HVAC and mechanical equipment.

Equally important is the handoff to the client: provide homeowners with the operating manuals for the heat pump and all other installed mechanical equipment. This documentation is crucial for the owner's warranty, proper operation, and maintenance scheduling.

Proper HVAC installation and ongoing maintenance protocols are essential steps for mitigating the risk of refrigerant leaks, regardless of the gas used. This demonstrates a commitment to both performance and environmental responsibility.

**Benefits:**
Durability



# Other mechanical equipment (HVAC) best practices

» **Design and build homes that stand up to changing climates** (NRCAN)
When selecting equipment (especially cooling), consider whether peak temperatures are expected to change during equipment life and whether upsizing is appropriate.

» **Make zoning choices deliberately** (Single Zone Cooling Guide)
Multi-zone cooling can provide benefits even for single family homes if installed and utilized thoughtfully. However, in many cases, single zone cooling's familiar approach is more appropriate for homeowners.

» **Install mechanical ventilation** (BC Housing Heat Recovery Ventilation Guide)
Even if not required to meet efficiency requirements, HRVs/ERVs can provide further improvements and benefits such as increased filtration during smoke events.

» **Add extra exhaust fans** (Metro Vancouver Thermal Safety in Multi-Unit Buildings)
Although HRV/ERVs are a higher priority, fans also improve airflow/passive cooling with low energy usage. Both bathroom and standalone fans can be used for these purposes. This is especially relevant for rooms/suites with only one façade connected to the outside.

» **Design for higher filtration** (BC Energy Step Code Guide Supplemental)
It is best practice to allow for higher level filters to be swapped in during times of poor air quality. Dedicated DOAS with higher level filters allow for more resilient, comfortable spaces.

» **Use active makeup air systems** (TECA - About Ventilation)
Good quality air barriers reduce the draftiness of homes dramatically. Failing to provide another intentional source of makeup air can lead to problems with negative pressure (stuck doors) and insufficient fresh air for any combustion-related products and appliances. In buildings with good airtightness the rules of BC Building Code Section 9.32 become even more important.

» **Locate fresh air intakes carefully** (BC Energy Step Code Guide Supplemental)
Ensure any air intakes to mechanical ventilation systems are located as far away from allergens and pollutants as possible, and on the shaded side of the building. Protect intakes from pests and animals.

» **Make vents blockable** (FireSmart BC Wildfire Preparedness Checklist)
FireSmart recommends that homeowners cover or block vents on their property if they are evacuating. Vents which are not easily accessible are not easily blocked.


*High performance HRV system*

# Best practices for electrical and energy systems


*Heat Pump Water Heater, Net Zero Home*

The practices in this section cover the systems that transmit electrical energy into and throughout the home. High performance homes often have a higher electrical service demand due to the increased reliance on efficient electrical heating, cooling and appliances. These systems require unique planning, particularly where major components and wiring are located and how they interface with the building's envelope and other mechanical systems.

Builders should strive to engage with electricians as early as possible in the design process to understand the needs their build will have.

> As builders or buyers increasingly incorporate on-site battery energy storage systems, they must be fully aware of battery capacity limitations and safety criteria for installation within homes. Proper installation, ventilation and access are critical safety considerations for these systems.

## IN THIS SECTION

# Put key equipment inside the air barrier

The integrity of the air barrier is critical to building performance. Every penetration through this continuous membrane is a potential weak spot. Of the many penetrations a building requires, few are harder to seal effectively than bundles of wiring leading to the electrical panel and large ductwork for the indoor air handler.

To reduce this risk, locate this equipment so you do not need to penetrate the air barrier at all. The best strategy is to place the electrical panel on an interior wall, never an outside wall or in a garage. Position the indoor air handling unit inside a utility space that is fully within the thermal envelope.

**Benefits:**
Lower costs

# Use efficient lighting and appliances to free up capacity

Switching from gas to electric mechanical systems is often the key to hitting higher step code targets, but it can increase the demand on the home's electrical panel. Capacity upgrades are costly, so builders often need to design homes close to the panel's upper limit.

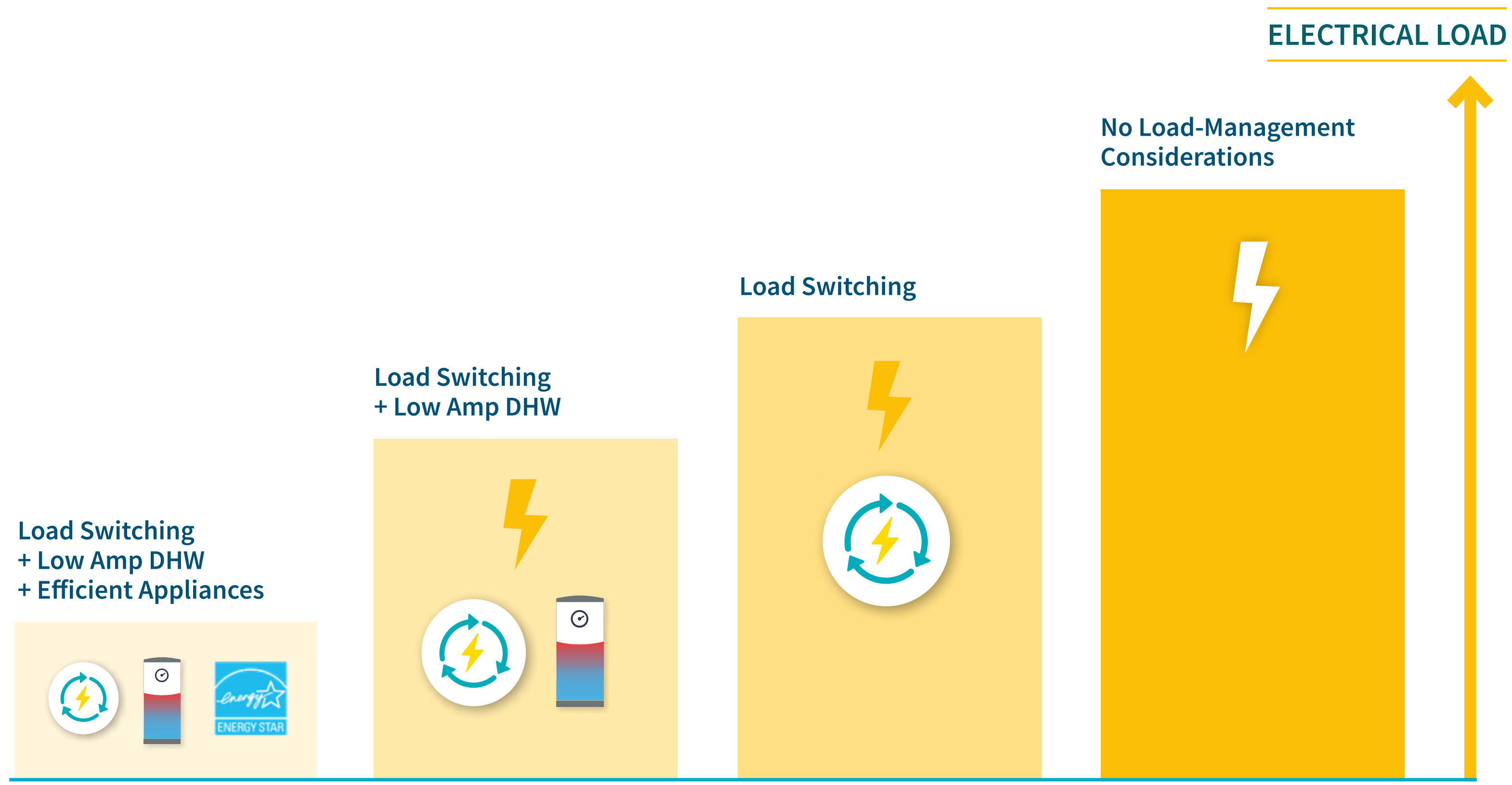
Accurate electrical calculations are essential to confirm capacity, but even with proper sizing, high demand appliances such as steam showers and hot tubs can strain the system.

**To free up capacity:**

- Install load switching or management devices where permitted. These are currently allowed for EV chargers, and codes are expected to expand to other appliances.
- Use lower amperage hot water systems such as 15-amp heat pump tanks
- Choose more efficient LED lighting and ENERGY STAR appliances. While these do not currently earn energy credits under NRCan modeling, they save energy now and may free capacity for later upgrades or additions.

**BUILDER TIP:** Current NRCan modeling protocols may not credit efficient lighting, appliances, or low-flow fixtures, but incorporating them is best practice. Codes and standards evolve, and these measures help future-proof the home.

**Benefits:**
Lower costs



# Plan for energy storage

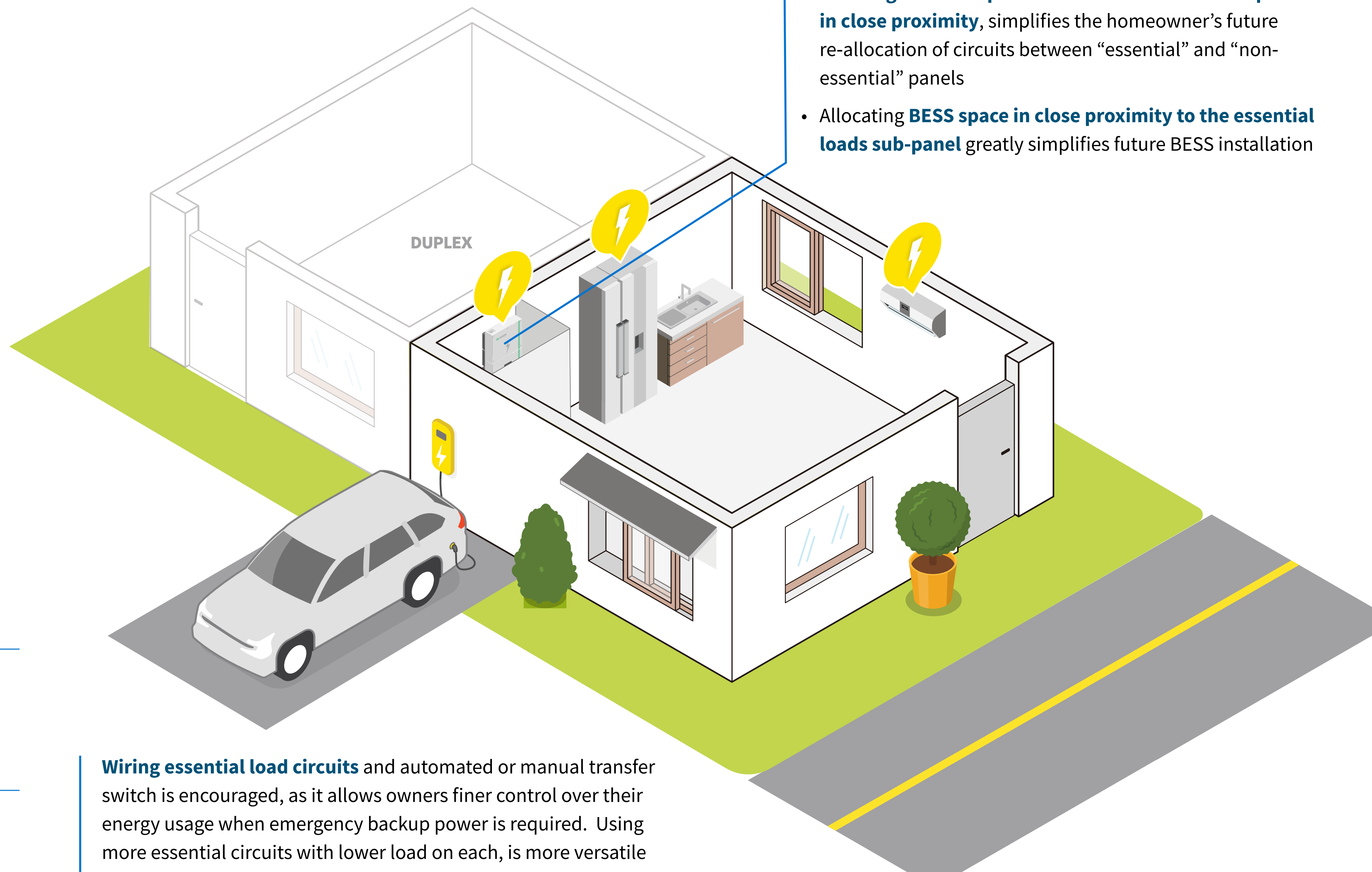
Residential battery energy storage systems (BESS) are becoming more commonplace with improving affordability, utility incentives, and the growing need for housing resilience against electrical utility service interruptions and tariff changes. Government incentives for solar-ready homes also support this trend, since solar PV and BESS are highly synergistic and most advantageously deployed together. Builders should expect to install more systems in new builds and plan for future integration.

Important considerations include:

- **BESS systems** should be sized to provide both sufficient maximum power and energy storage to support "essential loads" such as refrigerators, freezers, communications equipment, sparse plugs and lighting, and other outage crucial loads for typical outage durations.
- **Providing space for BESS within the building envelope** where permissible can avoid additional envelope penetrations for later BESS installation. While Canadian Electrical (CE) Code allows for BESS within living spaces, builders are highly advised to engage with electrical safety authorities to solidify acceptable BESS placement well in advance of construction.

**Benefits:** Durability; Climate resilience

- **Dedicating an electrical sub-panel** for Essential Loads circuits to be backed up by BESS during grid outages, greatly simplifies present or future BESS deployment
- **Locating the main-panel and essential loads sub-panel in close proximity**, simplifies the homeowner's future re-allocation of circuits between "essential" and "non-essential" panels
- Allocating **BESS space in close proximity to the essential loads sub-panel** greatly simplifies future BESS installation




**Wiring essential load circuits** and automated or manual transfer switch is encouraged, as it allows owners finer control over their energy usage when emergency backup power is required. Using more essential circuits with lower load on each, is more versatile than using fewer essential circuits with more load.

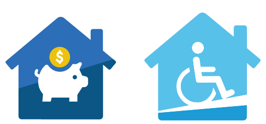
# Avoid phantom loads

Phantom loads, or standby loads, are the electrical loads that come from electronic devices which are not being actively used, or are in use unnecessarily. Between TVs, home computers, coffee makers, and other devices, these phantom loads can add up to a substantial portion of a home's energy bill.

The typical advice for dealing with these phantom loads is for homeowners to unplug these devices completely when they aren't in use. However, this is rarely implemented in practice, both because unplugging multiple devices multiple times daily is tedious and because plugs are often hidden away in difficult to reach places.

To provide a better product for homeowners, builders should consider three easy solutions to these problems:

- **Switched outlets**, which can be disabled from easy-to-access switches, provide an easy way for homeowners to disable multiple devices at once. In some cases, switches can be used to cut power to an entire room. These switches should be placed conspicuously in accessible locations.
- **Accessible outlet locations** provide homeowners, particularly those with mobility limitations, an easier way to unplug individual devices when they aren't in use. Builders should consider installing outlets at an appropriate height and location to allow those devices to be unplugged without bending down or crawling under furniture.
- **Designing around constant power draw** can mitigate large phantom loads from devices like sump pumps. Installation below the local high water table can lead to frequent sump pump operation. Close attention should be paid to basement depth relative to the local high water table, seasonal precipitation and freshet patterns.



**Benefits:** Affordable; Accessible

# Other electrical and energy systems best practices

» **Use the Canadian electrical code to calculate loads** (CSA Online Learning)

Most homes with legal secondary suites and car charging can fit on a 200 amp service with proper calculations, based on the Canadian Electrical Code. However, using rules of thumb is not acceptable practice. These calculations MUST be done to verify the appropriate connection size.

» **Size the EV circuit for the needs of the home** (Technical Safety BC and City of Vancouver)

Using Electrical Vehicle Energy Management Systems (EVEMS) can reduce electrical service size needs. Most homeowners, especially those with short and predictable commutes, do not regularly need very fast charging at home. For many households, a full overnight charge is acceptable; 20–30 amps is sufficient for most cars.

» **Use new 320A option for single family dwellings if appropriate** (BC Hydro)

BC Hydro now offers a 320A connection service in some areas, providing a good option in between the older 200 and 400A options.

» **Stay up to date with electrical codes** (Technical Safety BC)

Certain technical solutions which are available today (such as smart panels) may not yet be permitted by code but may be in the future. Some solutions, if permitted, will enable substantial cost savings.

# Closing

Following these best practices and targeting higher step code levels are investments that pay off in multiple ways. They deliver superior comfort and performance for occupants, reduce long-term liability for builders, and strengthen your position in a competitive market. Builders can use this guide as a roadmap to deliver homes that are high-quality, affordable, and better prepared for the climate challenges ahead.

### Mitigating risk and ensuring quality

Applying these methods helps prevent the most common and costly issues in construction, including compliance failures and project delays. Early planning for air barriers and mechanical systems, combined with proven quality control steps, such as mock-ups and mandatory inspection points, reduces rework and keeps projects on schedule.

Following standards like CSA F280 for duct sizing and CSA C273.5-11 for heat pump commissioning ensures systems perform as designed, avoiding blower door test failures and warranty claims. Clear communication and collaboration during pre-design helps eliminate job site conflicts, improving trade efficiency and accelerating project completion.

### The value of higher step code levels

Homes built to higher step code levels offer clear advantages over minimum-code construction. A high performance envelope provides passive survivability during outages and extreme heat events, protecting occupants and the structure. These homes also deliver predictable energy savings, lowering utility bills and increasing long-term market appeal.

### Future-proofing and market advantage

Building to higher performance standards today prepares homes for future restrictions or price disadvantages concerning carbon emissions from heating. Prioritizing electrification-ready systems and envelope performance now avoids costly retrofits later. High performance homes stand out in the market as durable, efficient, and safe for the climate challenges of the coming decades.

> *"We build high performance homes for less than our competition builds code minimum homes. It's easy to sell a better home for less than your competitors. We just proved it by selling out Phase 1 of our Alders project with the help of just 6 print ads in our local paper for marketing, no show home or showroom required."*
>
> *- Rod Nadeau, Managing Partner, Innovation Building Group*