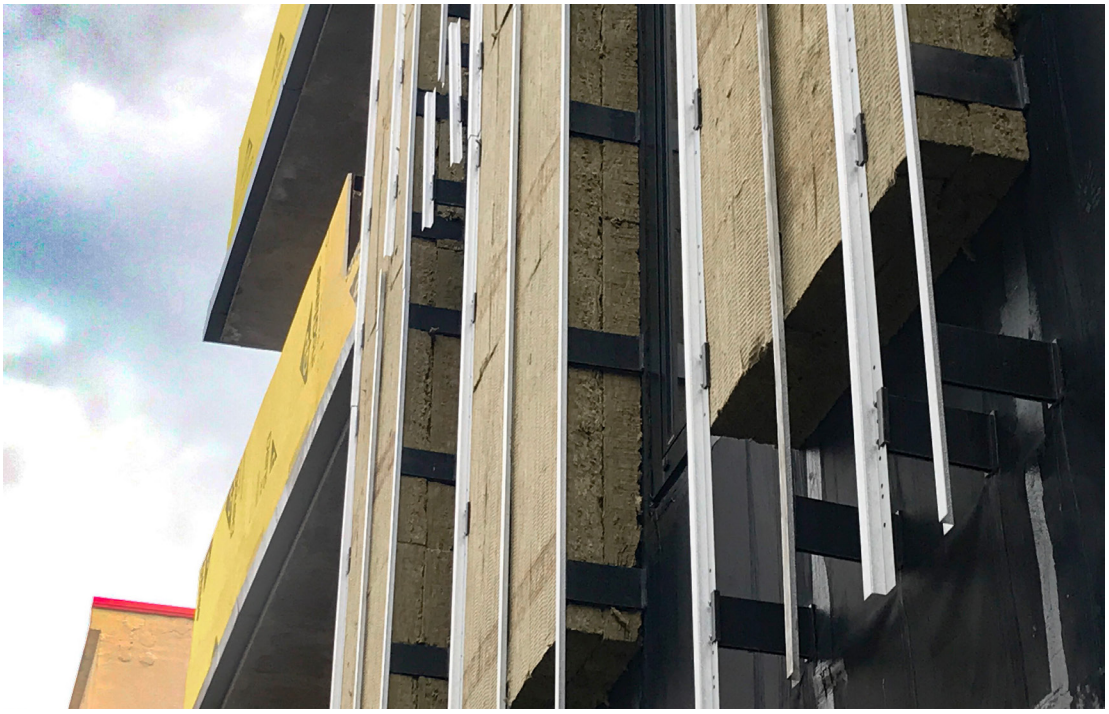
tech overview

applicable building types
all buildings
implementation
at mid-cycle or refinance
fast facts
- increases GHG savings
- improves acoustics
- improves comfort
- reduces heat and cooling loss
- enhances building performance

tech primer

Wall Insulation

High performance insulation improves comfort and saves energy while reducing utility bills and long-term maintenance costs.



cost & benefits

GHG savings

Tenant Experience Improvements

Utility Savings

Capital Costs

Maintenance Requirements

*ratings are based on system end use, see back cover for details.

Getting to know wall insulation

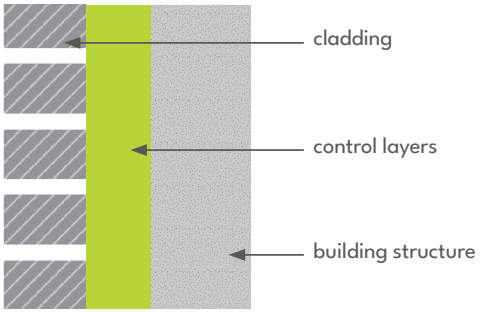
Insulation, in tandem with other enclosure elements, plays a critical role in moderating indoor comfort. Optimizing the type, amount, and location of insulation can hugely improve comfort and lower utility bills.

Why upgrade wall insulation?

For older buildings, and for new buildings targeting high performance, careful upgrading of insulation is among the most effective means of reducing energy use and improving interior comfort. When upgrading existing buildings, insulation can be applied to the interior or, as preferred, the exterior. Coupled with high performance windows and proper air sealing, insulation upgrades can, in some cases, eliminate the need for perimeter heating.

The envelope of a building keeps the outside outside—controlling the transmission of heat, air, water vapor, and moisture. All of these factors are managed by a series of control layers, including insulation, which must be correctly installed and coordinated in order to successfully create a protective enclosure. Each control layer interacts with, and influences, the others. Improper design or installation of control layers can result in the uncontrolled intrusion of water, air and vapor, leading to occupant discomfort, high energy bills and even structural damage.

Fig 1. Basic wall construction



Control layers include:

- Thermal protection: The combination of materials (mostly insulation) which reduce heat loss (or gain) between conditioned spaces and the exterior.
- Air barrier: A continuous set of materials which prevent the movement of air through the envelope, including at penetrations. Poor air barriers are responsible for the vast majority of heat loss and moisture intrusion, undermining the effectiveness of insulation. Window and door assemblies are part of the air barrier, but it can also include sealants, fluid and sheet membranes, and weather-stripping. Every building requires a continuous air barrier.
- Vapor control: Distinct from the air barrier, the vapor control layer mitigates the diffusion of water vapor through building materials. The type and position of vapor control required is determined by the type of wall assembly, the local climate, and the anticipated pressure conditions. The importance of vapor control increases with the amount of insulation and level of airtightness.
- Water barrier: The layer of materials, often a fluid-applied or sheet membrane, installed to keep water out of the building interior.

Assess
Always consult a qualified service provider before undertaking any building upgrades.

Coordinate Upgrades for Maximum Savings
Optimize upgrades to wall insulation by ensuring airtightness and vapor control layers are correctly specified and insulated.

To maintain comfortable and efficient indoor space temperatures, optimize all the "control layers" in the wall assembly.

Plan Ahead for Success
The best time to implement wall insulation upgrades is during refinancing or when other envelope improvements are scheduled.

Insulation upgrades should be considered during scheduled window replacement or air-sealing upgrades to save cost and reduce disruption to residents.

How to upgrade wall insulation

Upgrading wall insulation in conjunction with air sealing and the installation of high performance windows and doors completes a whole building envelope retrofit that will greatly enhance building performance.

Retrofit solutions

Applying insulation to the exterior is always preferred. But other factors—including historic preservation restrictions, costs, zoning requirements, space restrictions, and aesthetics—may dictate that an interior application be considered. The target for insulation performance should be based on long-term planning of all building systems, not just meeting current code. In any case, designers should use WUFI or other software to analyze the movement of heat and moisture through the assembly, and carefully analyze any thermal bridging conditions.

A **Exterior Insulation –** Rainscreen systems offer the highest performance as well as greatest durability and most flexible aesthetics. External Insulation and Finishing Systems (EIFS), though not as durable and with limited aesthetic options, are far less expensive and are the most prevalent exterior insulation method.

1. Rainscreen Systems
- Rainscreens include a grid-like frame attached to the façade, with control layers installed between and beneath this framework. Exterior panels are attached to the framework.
- The control layers are typically separate
- They can either replace or cover existing exterior finishes (bricks, panels, etc.)
- Points of attachment should be carefully designed to limit thermal bridging

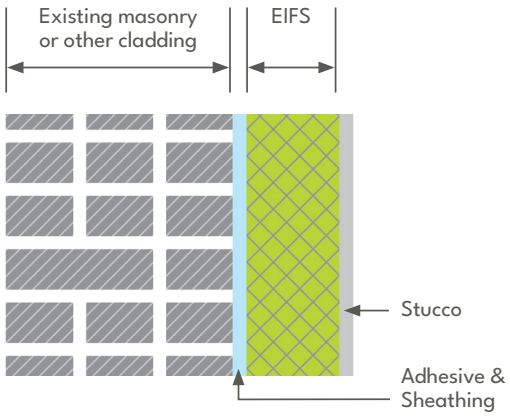
2. Exterior Insulation and Finish System (EIFS)
- Incorporates all control layers into one system
- Install options: Either adhere directly to existing brick, or, if brick is not sound enough, mechanically fasten exterior sheathing to brick, then adhere system to sheathing
- Adhesive acts as air barrier
- Pay special attention to proper drainage, as standing moisture within EIFS can cause significant damage.

B **Interior Insulation –** Adding insulation to interior walls preserves the aesthetic of the exterior but carries risks due to moisture intrusion and freeze/thaw cycles.

1. Analyze Conditions
- Prior to insulating, confirm wall is not exposed to excessive water and carefully analyze moisture and freeze/thaw cycle impacts on assembly to determine location and type of vapor control layer(s).
- Apply form fitting insulation such as batts at interior face of exterior wall, typically with inboard air barrier.
- Walls and floors that meet the exterior walls represent thermal bridges; determine mitigation measures, if any.

2. Install Insulation System
- If insulating between studs, provide a continuous layer over or behind studs to mitigate thermal bridges
- Stagger and tape all joints
- Use loose fill to close gaps or cavities (Avoid high toxicity products like spray foams)
- Carefully seal around all wall penetrations (most especially joists)

Fig 1. EIFS typically contain a layer of sheathing fastened to the existing brick or other cladding material, with the insulation adhered directly to the sheathing.



Costs and benefits of insulation upgrades*

Greenhouse Gas (GHG) Savings

A moderate reduction in heating and cooling related GHG emissions can be expected from a wall insulation upgrade, depending on the existing condition of the building envelope and the current heating and cooling demand. Air sealing is critical to realizing these reductions, and are multiplied if window improvements are also undertaken.

Tenant Experience Improvements

Wall insulation upgrades, when combined with comprehensive air sealing, will significantly improve resident comfort by eliminating drafts, improving temperature distribution, and reducing pollution and noise infiltration.

Utility Savings

A moderate amount of utility savings can be achieved through the reduction of heating and cooling loads inherent in improving building envelope performance.

Capital Costs

Wall insulation upgrades require a large capital investment, and are best implemented when other repair work is scheduled, such as repairs precipitated by Local Law 11 compliance.

Maintenance Requirements

Properly designed and installed exterior insulation systems (EIFS, rainscreen, etc.) should require little maintenance. If insulation is applied to the interior of brick facades, regular re-pointing is critical to minimize rain water penetration and freeze-thaw damage. Regular inspection and cleaning of weep holes is critical to ensuring proper water drainage.

Take Action

This document is one of more than a dozen High Performance Technology Primers prepared by the Building Performance Partnership (BPP) to introduce decision-makers to solutions that can help them save energy and improve comfort in their buildings.

For more information, contact
The Building Energy Hub:
Email: info@buildinghub.energy

The Building Performance Partnership (BPP), created by Building Energy Exchange (BE-Ex) and the Institute for Market Transformation (IMT), supports the creation and operation of local high-performance building hubs that accelerate measurable, equitable, and sustainable action to improve the health, comfort, and performance of buildings. With support from both BE-Ex and IMT, partner hubs serve their respective regions with customized resources that cater to the needs of their communities while benefiting from the existing resources and expertise of our network.

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*The Costs & Benefits rating system is based on a qualitative 1 to 4 scale where 1 () is lowest and 4 () is highest. **Green** correlates to savings and improvements, **dark blue** correlates to costs and requirements. Ratings are determined by industry experts and calculated relative to the system end use, not the whole building.

Note: GHG and utility savings are dependent on existing window conditions and are based on the heating and cooling loads. Assumes existing windows are leaky, un-insulated, and without special coatings.