tech overview

applicable building types
all buildings
implementation
at roof replacement, mid-cycle or refinance
fast facts
- improves acoustics
- improves building lifespan
- reduces heat and cooling loss
- enhances building performance

tech primer

Roof Insulation

High performance roof insulation upgrades that improve the building envelope.

Destinee Sweeney/U.S. Air Force

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.

bpp+

Building Performance Exchange

A program of Built Environment Plus

Getting to know roof insulation

As part of a building's envelope, roof insulation plays an important role in moderating indoor temperature. Upgrading roof insulation improves the lifespan of the building and lowers operating costs by reducing demand on the building's heating and cooling systems.

Why improve roof insulation?

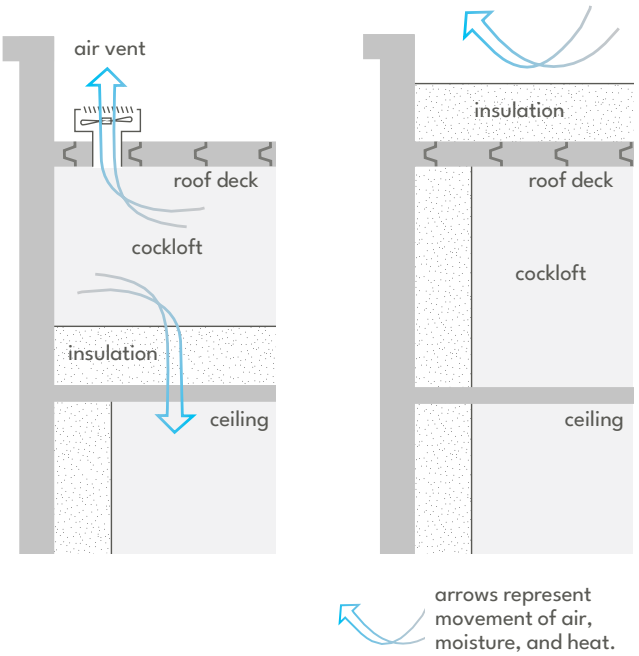
All buildings must periodically repair or replace their roof as part of general building maintenance. This represents an opportunity to implement a high performance retrofit that, along with wall insulation upgrades, window upgrades, and air-sealing, will improve the building envelope (the barrier between the inside and outside of a building), and in turn enhance heating and cooling systems and general building performance.

Existing buildings typically have roof insulation installed either above or below the roof deck. In buildings where insulation is located below the roof deck, blown-in fiberglass or cellulose insulation is located above the top floor ceiling, leaving the space from the ceiling to the roof deck (known as a cockloft) un-insulated (see Fig 1). In this scenario, air leaks, drafts, and infiltration of moisture are common because sufficient air sealing is too difficult to achieve. Heating and cooling systems work harder to compensate, while indoor air quality and comfort are compromised.

This tech primer focuses on high performance opportunities for buildings with insulation located below the roof deck, outlining a retrofit that improves occupant health and comfort, increases the building's life span, reduces heating and cooling costs, and saves energy by moving insulation above the roof deck (see Fig 2).

Fig 1. Before retrofit: A roof with insulation below the roof deck (at the top floor ceiling), relies on an insufficient barrier to prevent drafts, air and moisture infiltration, resulting in energy loss and high heating and cooling loads.

Fig 2. After retrofit: Proper insulation and air sealing is achieved, resulting in a substantial reduction of drafts, air and moisture infiltration.



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

Coordinate Upgrades for Maximum Savings
Implementing a roof insulation upgrade in conjunction with installing a Solar PV system and/or a green roof ensures that requirements for both retrofits are successfully coordinated.

Conducting these retrofits together saves time and reduces construction costs.

Plan Ahead for Success
The best time to implement roof insulation upgrades is during mid-cycle, refinancing, or when the roof needs replacement.

Insulation upgrades may be code mandated depending on specific circumstances.

How to upgrade roof insulation

Improving roof insulation in conjunction with window and wall insulation upgrades completes a whole building envelope retrofit that will greatly enhance building performance.

Retrofit solutions

A high-performance roof retrofit requires sealing any existing roof vents and placing insulation above the deck. Correct installation of the vapor barrier is required so that water vapor does not condense within the assembly. There are multiple steps to completing a high-performance retrofit:

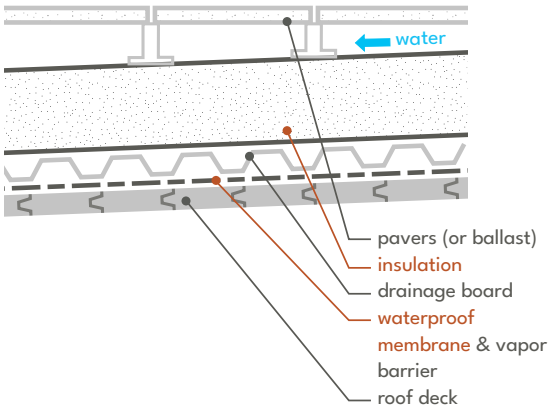
A **Eliminate Vents –** Roof vents are commonly found in older, low to mid-rise properties originally constructed without any insulation.

- Eliminate roof ventilation and insulate and seal the interior walls of the cockloft to create a proper air barrier (see Fig. 1 & 2, pg. 2).

B **Add Insulation Above the Roof Deck –** First, verify that space is available for new insulation. Roof access doorways and existing flashing and counter-flashing may need to be raised or modified to accommodate insulation thickness. Then, apply rigid insulation above the roof deck and either above (1) or below (2) the roof membrane:

1. If the existing roof deck slopes towards the drains, apply insulation above the roof membrane (see Fig. 3, below):

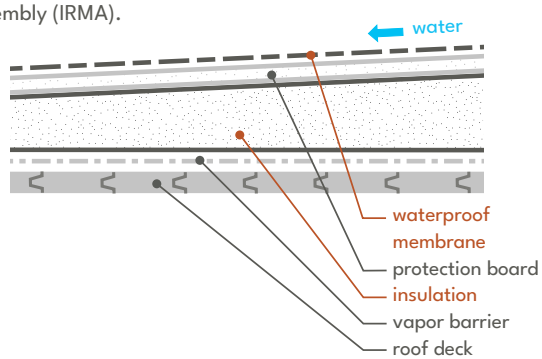
Fig 3. Roof construction assembly with insulation above roof membrane.



- Apply water-resistant insulation, such as extruded polystyrene, and install drainage board below the insulation to encourage water drainage.
- Secure insulation in place with ballasts or pavers. Some rigid insulation systems come with ballast attached.
- In some retrofit applications, the additional weight of ballast or pavers may be a concern. It is important to confirm the building structure can support additional weight before starting a retrofit.
- The waterproof membrane is protected by the insulation, increasing durability and life span.

2. If the existing roof deck does not slope towards the drains, apply insulation below the roof membrane (IRMA) (see Fig. 4, below):

Fig 4. Roof construction assembly with insulation below roof membrane, commonly referred to as an inverted roof membrane assembly (IRMA).



- Install a vapor barrier below the insulation.
- Slope the surface of the insulation towards drains using tapered insulation boards.
- Cover insulation with protection boards and apply roof membrane on top.
- Ensure the type of waterproof membrane selected is appropriate for exposed conditions.

Note: For roof areas where rigid insulation is too difficult to apply, such as curved or domed surfaces, spray foam insulation with a protective silicone or elastomeric coating can be installed as an effective alternative.

C **Create a Cool Roof –** Apply a white or light colored finish to the roof to reflect sunlight and absorb less heat, reducing the building's cooling demand on hot days.

Costs and benefits of roof insulation retrofits*

Greenhouse Gas (GHG) Savings

A roof insulation retrofit can increase energy savings of a building's heating and cooling system, leading to reduced heating and cooling related GHG emissions.

Tenant Experience Improvements

A roof insulation retrofit prevents the buildup of condensation that causes damage to the property and to occupants' health. Well insulated and sealed roofs improve the building envelope, increase indoor air quality by reducing air infiltration and drafts, and create a more comfortable indoor environment.

Utility Savings

A small amount of utility savings can be achieved through the reduction of heating and cooling loads inherent in improving roof insulation.

Capital Costs

Roof air sealing and insulation upgrades requires a large capital investment, and are best implemented at roof replacement or major repair.

Maintenance Requirements

A low level of maintenance is required for an upgraded roof. Inspections to verify proper drainage and surface condition must be performed periodically. Follow manufacturers guidelines for repairs and maintenance.

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 Built Environment Plus.

Contact:
exchange@builtenvironmentplus.org
617-752-2422

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.

building performance par+nership

*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.

© Building Energy Exchange
All Rights Reserved