solution package

Building Envelope

A guide to building envelope solutions that improve comfort, marketability, and energy efficiency.

The BE-Ex solution packages are a suite of six documents compiled from the Anatomy of an Energy Efficient Building exhibit on view at Building Energy Exchange’s downtown resource center, or virtually at be-exchange.org/anatomy.
The performance of mechanical building systems is contingent on the integrity of the building envelope. Building envelope upgrade decisions should be made in the context of how they might impact the operation and performance of mechanical systems.

### System Interaction

<table>
<thead>
<tr>
<th>Envelope</th>
<th>Ventilation</th>
<th>Heating</th>
<th>Hot Water</th>
<th>Cooling</th>
<th>Lighting &amp; Loads</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>2</td>
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1. **Envelope → Ventilation**

   Envelope upgrades must be paired with balanced fresh air ventilation to ensure indoor air quality and health benefits.

2. **Envelope → Heating & Cooling**

   Improvements to the building envelope will reduce the need for heating and cooling, saving energy and minimizing operating costs.

### Operations & Maintenance

Investing in operations and maintenance best practices ensures that building systems run optimally, enabling proper performance in existing equipment and maximizing return on investment in new systems. Best practices for building envelopes include:

- Weatherstrip windows and door frames, replace gaskets, and air seal around air conditioners, vents, shaft openings, piping penetrations, and cracks along walls and joints.
- Routinely inspect building for air and heat leakage using infrared cameras to identify thermal bridges and smoke blowers to locate air leaks.
- Inspect each envelope component from both the exterior and interior of the building.
- Establish a winter maintenance policy for window and through-wall air conditioners.
- Apply reflective, light-colored paint to the building’s roof.
Building envelope improvements include creating an airtight barrier to reduce infiltration through gaps and holes in exterior walls and roofs, upgrading doors and windows to higher performance models, ensuring continuous and sufficient insulation at walls and roofs, and minimizing thermal bridging.

**Key**

**EASE OF IMPLEMENTATION**

<table>
<thead>
<tr>
<th>EASE</th>
<th>not easy</th>
<th>moderately easy</th>
<th>very easy</th>
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</table>

**Ease of Implementation** reflects technical and financial feasibility.

Measures marked “not easy” are typically expensive, complex, highly disruptive, or pay back slowly, while “very easy” measures tend to be in-expensive, quick, and straightforward.

**PROJECT IMPACT**

<table>
<thead>
<tr>
<th>IMPACT</th>
<th>low impact</th>
<th>moderate impact</th>
<th>high impact</th>
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**Project Impact** reflects potential to reduce energy and emissions and to improve system performance.

“Low impact” measures typically yield minor savings and incremental improvements, while “high impact” measures achieve major savings and comprehensive improvements.

**ADDED BENEFITS**

**operations & maintenance**

Keeps building performing optimally when completed on a routine basis

**health & comfort**

Enhances indoor environmental quality and advances occupant wellbeing

**marketability**

Improves aesthetics and upgrades occupant spaces, increasing appeal to potential tenants

**future-ready**

Puts building on path for long-term emissions reduction and legislative compliance

**RATING SYSTEM METHODOLOGY**

Ratings and benefits of energy conservation measures were assigned based on NYC energy audit data and analysis by industry experts. Actual results will vary by building type, use, and baseline conditions.

**Stop Drafts and Air Leakage**

**Airseal Window & Door Frames**

Apply caulk and weather-stripping materials like rubber, foam, or vinyl to seal frames.

**Seasonally Maintain Room ACs**

Remove and store or cover and weatherize AC units after each cooling season to minimize air leakage.

**Identify & Seal Additional Air Leaks**

Use blower door or smoke tests to find leaks. Common culprits include piping penetrations, recessed lighting, outlets, and laundry vents.

**Airseal Room ACs**

Use a trim kit, weatherstripping, and caulk to create a snug fit around window and through-wall ACs.
envelope efficiency measures

Stop Drafts and Air Leakage, cont.

**Air Seal Vertical Shafts**
Cover elevator and stairwell vents (partially or fully, per NYC code) to reduce heat loss, especially in tall buildings.

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**Install Continuous Air Barrier**
Best started in design phase of new construction/gut rehab. Options are also available for retrofits. Ensure continuity via careful detailing.

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Control Temperature and Moisture Levels

**Optimize Wall Insulation**
Best started in design phase. Install insulation to meet code and modeled building needs. Ensure continuity via careful detailing.

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**Optimize Floor Slab insulation**
Best started in design phase. Optimize floor slab insulation in conditioned spaces.

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Control Temperatures and Moisture Levels, cont.

**Optimize Roof Insulation**
Install insulation to meet code and modeled building needs. Coordinate with other roof measures, like solar and green roofs.

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**Mitigate Thermal Bridges**
Install thermal break materials to minimize transfer of heat and moisture.

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Maximize Thermal Comfort

**Consider Interior Window Treatments**
Install thermal shades or blinds to insulate windows and prevent solar heat gain. Add daylight controls to maximize benefits.

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**Consider High Performance Window Coatings**
Apply insulating, reflective and/or smart coatings to increase thermal performance of existing windows.

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envelope efficiency measures

Maximize Thermal Comfort, cont.

<table>
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<tr>
<th>Install High Performance Exterior Doors</th>
<th>Consider Exterior Shade Structures</th>
<th>Install High Performance Windows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install well-insulated, thermally broken doors and frames with robust gasketing.</td>
<td>Consider adding shade structures that minimize summer heat gain, particularly in new construction projects.</td>
<td>Install well insulated, thermally broken glazing and frames with robust gasketing.</td>
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Evaluate Sustainable Roof Options

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<thead>
<tr>
<th>Install Solar Photovoltaic (PV) Panels</th>
<th>Install Green (Vegetative) Roof</th>
<th>Apply Cool Roof Coating</th>
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<tbody>
<tr>
<td>Required for many buildings by NYC law. Solar PV can offset energy use, especially during peak sunlight hours or when paired with batteries.</td>
<td>Required for many buildings by NYC law. Green roofs improve insulation while decreasing stormwater runoff.</td>
<td>Required for many buildings by NYC law. Apply a light-colored reflective coating to reduce unwanted heat gain.</td>
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be-exchange.org/anatomy
Further Reading

The BE-Ex solution packages cover the following building systems:

- Heating
- Cooling
- Ventilation
- Domestic Hot Water
- Lighting & Plug Loads
- Envelope

To access the suite of solution packages, visit: be-exchange.org/anatomy-solutions

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