Heating

A guide to heating system solutions that improve comfort, marketability, and energy efficiency.
The performance of heating systems is often contingent on the function of other building systems. Heating upgrade decisions should be made in the context of how other systems will impact heating operation and performance.

1. **Envelope → Heating**
   - Building envelope improvements that minimize heat loss, such as increasing air tightness and insulation, help reduce demand on the heating system.

2. **Ventilation → Heating**
   - Energy recovery ventilation (ERV) systems use a building’s waste heat to precondition incoming air, reducing demand on the heating system.

3. **Hot Water → Heating**
   - Many heating systems and domestic hot water systems share a single, large boiler. These boilers waste considerable amounts of fuel heating up water when space heating is not also needed.

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 heating systems include:

**Steam and Hydronic Systems:**
- Inspect and repair terminal units.
- Monitor set points and re-calibrate sensors and controls on a regular basis to maximize and maintain efficiency.
- Test chiller refrigerant for oil contamination.
- Modify chiller refrigerant levels to optimize power consumption.
- Inspect and clean condenser and evaporator tubes and treat chiller water to prevent scale, corrosion, and bacterial growth.
- Conduct routine equipment surveys and maintain a daily operating log.

**Heat Pumps:**
- Periodically clean or replace air filters in indoor units and annually clean and powerwash outdoor units.
- Test for refrigerant leaks before and after each heating season, starting within one year of installation.
- Seal gaps between walls and refrigerant piping or heat pump units.
- Educate tenants in proper use of heat pumps, particularly when systems are tenant controlled.
heating efficiency measures

Minor improvements to existing systems offer noticeable benefits to both landlords and tenants. Wholesale system conversion (such as switching from steam heat to electric heat pumps) yields even greater benefits in terms of long-term energy savings, tenant comfort and emissions reductions.

Key

<table>
<thead>
<tr>
<th>EASE OF IMPLEMENTATION</th>
<th>ADDED BENEFITS</th>
</tr>
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<tbody>
<tr>
<td>EASE</td>
<td>operations &amp; maintenance</td>
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<tr>
<td>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 inexpensive, quick, and straightforward.</td>
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<tr>
<th>PROJECT IMPACT</th>
<th>IMPACT</th>
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<tr>
<td>IMPACT</td>
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<tr>
<td>low impact</td>
<td>moderate impact</td>
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<tr>
<td>high impact</td>
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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.

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.

ALL SYSTEM TYPES

Improve System Responsiveness

<table>
<thead>
<tr>
<th>Change Set Points/Setbacks</th>
<th>Install Indoor Room Sensors</th>
</tr>
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<tbody>
<tr>
<td>Many heating systems are programmed at higher settings than necessary. Lower the temperature set point or schedule setbacks to save energy.</td>
<td>Install indoor temperature sensors to improve the heating system’s ability to respond to actual heating needs.</td>
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ALL SYSTEM TYPES

Improve System Responsiveness, cont.

<table>
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<th>Install Window Sensors</th>
<th>Install Heating Controls</th>
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<tr>
<td>Install window sensors to detect when widows are opened in a space and turn off heat in that area.</td>
<td>Install central controls to regulate heat output, collect data, adjust setpoints, monitor the system remotely, and improve operations and maintenance.</td>
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# Heating Efficiency Measures

## Steam Systems

### Improve Boiler Operation & Efficiency

<table>
<thead>
<tr>
<th>Clean &amp; Tune Boiler</th>
<th>Replace or Upgrade Boiler</th>
<th>Upgrade Burner</th>
<th>Repair System Leaks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean and tune boiler to optimize performance and efficiency.</td>
<td>Size new boilers correctly to avoid inefficiencies. Many NYC boilers are oversized, resulting in heat and energy waste.</td>
<td>Install a modulating burner to adjust boiler heat output precisely and efficiently in response to changing heating demands.</td>
<td>Repair steam system leaks to reduce energy loss. Leaks often occur at pipe connections, fittings, and valves.</td>
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### Repair System Leaks

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### Ensure Quick & Even Heat Flow to Radiators

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<th>Install Thermostatic Radiator Valves (TRVs) or Enclosures (TREs)</th>
<th>Repair Steam Traps/Add Orifice Plates</th>
<th>Add Insulation</th>
<th>Install Master Venting</th>
</tr>
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<td>Install TRVs or TREs to give occupants ability to adjust radiator heat output and to enable building-wide or room-by-room setbacks and temperature limits.</td>
<td>Test steam traps for leaks to ensure proper operation. In two-pipe systems, steam traps can be substituted with orifice plates at each radiator.</td>
<td>Insulate exposed riser pipes to optimize heat distribution. Insulate condensate tanks and behind radiators to reduce heat loss.</td>
<td>Master venting enables air to escape the distribution system quickly, improving the flow of steam to radiators.</td>
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</tbody>
</table>

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**EASE** | **IMPACT** | **ADDED BENEFITS**
heating efficiency measures

HYDRONIC SYSTEMS

Improve Efficiency of Heating Equipment

Upgrade Terminal Units
Install terminal units capable of delivering heat at reduced distribution supply water temperatures.

Correctly Size Water Pumps
Right-size pumps to improve efficiency and better regulate speeds to meet changing heating demands.

Convert to Air-to-Water Heat Pumps
Replace boiler with an air-to-water heat pump for a high-efficiency electric alternative to a condensing boiler.

Install Pressure Independent Control Valves
Install pressure independent control valves at each terminal unit to provide both temperature and flow control.

Install Variable Frequency Drives
Install variable frequency drives (VFDs) on pumps to modulate speeds and maximize energy savings.

Replace or Upgrade Boiler
Install condensing boilers, the most efficient option for fuel-fired heating.

Balance and Improve Heat Distribution

EASE IMPACT ADDED BENEFITS

EASE IMPACT ADDED BENEFITS

EASE IMPACT ADDED BENEFITS

EASE IMPACT ADDED BENEFITS

HYDRONIC SYSTEMS

heating efficiency measures
# heating efficiency measures

## HIGH PERFORMANCE

### Install a High Efficiency Heat Pump Technology

<table>
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<th>Install Mini-Splits</th>
<th>Install PTHPs</th>
<th>Install VRFs</th>
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<td>Install mini-splits—a decentralized, room-scale, high efficiency electric technology that can be used for heating and cooling spaces.</td>
<td>Install Packaged Terminal Heat Pumps (PTHPs), single packaged, high efficiency heating and cooling units that can be installed in existing PTAC wall sleeves.</td>
<td>Install a Variable Refrigerant Flow (VRF) system—a high efficiency electric heating and cooling technology that can be configured in centralized or decentralized layouts.</td>
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</table>

**EASE** | **IMPACT** | **ADDED BENEFITS**
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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