

**tech overview**

- applicable building types
  - all multifamily, hotels
- implementation
  - at equipment replacement, at tenant turnover
- fast facts
  - reduces GHG emissions
  - improves comfort
  - provides individual temperature control
  - reduces maintenance costs
  - provides both heating and cooling

tech primer

# Packaged Terminal Heat Pumps (PTHPs)

Decentralized electric heating and cooling for multifamily buildings.



**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 PTHPs

Packaged Terminal Heat Pumps (PTHPs) are a compact and efficient heating and cooling technology that saves energy and reduces greenhouse gas emissions. PTHPs offer multifamily buildings a path to electrification.<sup>1</sup>

## How do PTHPs work?

Packaged Terminal Heat Pumps (PTHPs) are a decentralized air-source heat pump (ASHP) technology that can be used to heat and cool spaces. ASHPs are high-efficiency electric appliances that add or remove heat from an indoor space as needed. Because they transfer heat rather than generate it, ASHPs are extremely efficient.

PTHPs are single packaged units installed in metal sleeves typically located below windows in living spaces and bedrooms. During the summer, the unit operates as an air conditioner, cooling the indoor air by transferring heat to the outdoors. During winter, the system reverses and cools the outdoor air to warm the indoor air, even at low outdoor air temperatures. Occupants can adjust room temperature to their personal comfort levels using thermostatic controls.

PTHPs heat and cool spaces using refrigerant, and incorporate a back-up heating mode, typically electric resistance heat, for the lowest winter temperatures. PTHPs are packaged systems, which reduces the risk of refrigerant leaks with high global warming potential, as compared to Mini-Split and VRF systems, which often feature longer refrigerant runs.

PTHPs are excellent replacements to through-wall sleeve ACs and Packaged Terminal Air Conditioners (PTACs) because they can be inserted into the

existing metal sleeve with minimal adjustment. PTHPs offer a higher energy savings potential than through-wall sleeve ACs, which do not provide heat, and PTACs, which provide heat through hot water or steam coils that are fed by a central boiler plant (see our Air Sealing at Room Air Conditioners Tech Primer for more information on these ACs and relevant strategies for insulating around through-wall systems).

PTHPs are an emerging technology with a relatively low installation cost, however they require careful installation and proper controls to both provide effective winter heating and achieve maximum energy savings. PTHPs are suitable for many building types. This tech primer focuses on PTHP applications for large hospitality and multifamily buildings.

### Assess

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

<sup>1</sup>Electrification is a strategy to transition from powering building systems with fossil-fuels to electricity. Electrification is an important step towards a low-carbon future for NYC.

### Coordinate Upgrades for Maximum Savings

Installing PTHPs in conjunction with building envelope improvements (insulation, air-sealing, etc.) or other high-performance measures will reduce a building's heat loss and infiltration.

*With an improved building envelope, it may be possible to install lower capacity equipment, thereby reducing capital costs.*

### Plan Ahead for Success

Consider implementing a PTHP system when your existing heating and cooling systems have reached the end of their useful lives, or when windows or facade improvements are scheduled.

*Installing PTHP systems during other building improvements can save cost and reduce disruption to residents.*

## How to upgrade to PTHPs

The best time to implement a PTHP upgrade is during a window and facade renovation, or at the time of heating and cooling equipment replacement.

### Retrofit solutions

There are multiple steps to retrofitting a building with PTHPs:

**A Install PTHPs** – Wall openings and metal sleeves must be correctly sized to meet manufacturers' requirements and properly air sealed to minimize air leaks.

- Create new wall openings for each PTHP or adjust existing wall openings from PTACs or through-wall ACs.
- Seal all gaps between the wall opening and sleeve, and between the sleeve and PTHP unit.
- For buildings that use PTACs for cooling and a central boiler plant for heating, replace PTACs during normal maintenance and slowly decommission the central heating system.
- Apartments with steam and hydronic heat have terminal units located under windows so that heat is applied to the coldest part of the room. PTHPs follow the same logic and can replace terminal units in the same location.
- If not already provided, upgrade electricity service to 208/230V.

**B Control Condensate** – In cooling mode, condensate must be removed from the PTHP as the room is dehumidified. In heating mode, condensate is formed at the outdoor fan coil during defrost cycles and must be properly drained.

- Common condensate control methods include misting condensate into the fan on the outside of the unit, or adding interior plumbing lines to drain condensate.

**C Install Remote Room Temperature Sensors** – By default, PTHPs are controlled using temperature sensors located inside the PTHP box, which typically do not provide an accurate room temperature reading.

- Install a wall-mounted remote sensor that provides room temperature feedback to accurately control each unit's heating and cooling output.
- Without accurate room temperature feedback, the PTHP will go into back-up mode (typically electric resistance heat) in order to heat the space, unnecessarily increasing energy use.



Photo: Steven Winter Associates

Outdoor view of a PTHP



Photo: Steven Winter Associates

Indoor view of a PTHP

# Costs and benefits of PTHPs\*

## Greenhouse Gas (GHG) Savings



Converting a multifamily building to PTHPs can greatly reduce heating and cooling related GHG emissions, depending on the current heating and cooling system.

## Tenant Experience Improvements



Tenant experience will remain largely unchanged, however proper installation of PTHPs will improve the air tightness of the building envelope, which reduces drafts and improves comfort.

## Utility Savings



Although PTHPs consume significantly less energy than systems that use natural gas, fuel oil, or district steam, utility costs for operating PTHPs can be high due to the current cost of electricity. Future changes in utility costs should be considered when evaluating project feasibility.

## Capital Costs



The capital costs for conversion to PTHPs are moderate for buildings with existing PTACs. The project cost could be impacted if the building's electrical service needs upgrading, or if a new domestic hot water system needs to be installed with the decommissioning of a central heating plant.

## Maintenance Requirements



A properly installed PTHP system requires a moderate level of maintenance. Air filters need to be periodically cleaned or replaced. The entire PTHP can be removed in one piece and brought to a workshop for periodic service or as needed.

## 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.

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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: Existing system assumed to be gas-fired steam boiler, steam PTACs.