

Packaged Terminal Heat Pumps (PTHPs)

Decentralized electric heating and cooling for multifamily buildings.

tech overview

applicable building types
multifamily; hotels

when to implement equipment replacement;
tenant turnover

fast facts

- reduces GHG emissions
- provides individual temperature control
- provides both heating and cooling
- reduces maintenance costs

costs & 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 electric heating and cooling technology. Upgrading to PTHPs can significantly reduce energy use and carbon emissions.

how do PTHPs work?

Packaged Terminal Heat Pumps (PTHPs) are a decentralized air-source heat pump technology that can be used to heat and cool spaces. Heat pumps are high-efficiency electric appliances that add or remove heat from an indoor space as needed. Because they transfer heat rather than generate it, they are extremely efficient. See the *Mini-Split and Variable Refrigerant Flow Tech Primers* to learn about more heat pump options.

PTHPs are single packaged heat pump units that are installed in metal sleeves, typically located below windows in living spaces and bedrooms. Occupants can adjust room temperature to their personal comfort levels using the PTHP's thermostatic controls.

The unit operates as an air conditioner during the summer, cooling indoor air by transferring heat to the outdoors. During winter, the system reverses, pulling heat from the outdoor air to warm indoor air, even at low outdoor air temperatures. However, most PTHPs also incorporate a backup heating mode, typically electric resistance, for the lowest winter temperatures.

PTHPs heat and cool spaces using refrigerants, which can have a high global warming potential. Because PTHPs are packaged systems, they have

are at reduced risk of refrigerant leaks, compared to mini-split and VRF systems, which often feature longer refrigerant runs.

PTHPs are excellent replacements for through-wall sleeve ACs and packaged terminal AC (PTACs) because they can be inserted into existing metal sleeves 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 fed by a central boiler plant (see the *Air Sealing at Room Air Conditioners Tech Primer* for more information and strategies for insulating and air sealing around through-wall systems).

PTHPs are an emerging technology with a relatively low installation cost, however they require careful installation and proper controls to provide effective winter heating and maximize energy savings.

While PTHPs are suitable for many building types, this primer focuses on large hospitality and multifamily building applications.

Assess

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

Coordinate to Maximize 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 costs 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

Consider the following steps when retrofitting a building with PTHPs:

- A Install PTHPs:** Wall openings and metal sleeves must be correctly sized to meet manufacturer 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 to apply to the coldest parts 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 control each unit's heating and cooling output accurately.
 - Without accurate room temperature feedback, the PTHP will go into backup mode (typically electric resistance heat) 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 & 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.

**The Costs & Benefits rating system is based on a qualitative 1 to 4 scale where 1 (lowest) is lowest and 4 (highest) is highest. Green correlates to savings and improvements, orange 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.

take action

This document is one of more than a dozen High Performance Technology Primers prepared by Building Energy Exchange and its partners to introduce decision-makers to solutions that can help them save energy and improve comfort in their buildings. Access the complete Tech Primer library: be-exstl.org/building-blocks

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