Key Considerations for Adopting Commercial Heat Pump Rooftop Units

Introduction

Rooftop air conditioning systems or rooftop units (RTUs) are common, cooling nearly 50% of the U.S. commercial building floor area. Heat pump RTUs (HP RTUs) are technologically similar to air-conditioning RTUs (AC RTUs), but provide the additional benefit of reverse-cycle HP heating.

RTUs over 15 years old can waste substantial amounts of energy and money than newer models; however, facility managers often delay purchasing a new RTU until the current RTU no longer provides adequate space conditioning, requires frequent maintenance, or fails completely. In many instances, replacing inefficient and underperforming RTUs proactively with more energy-efficient units can be a smart business move, especially when compared with replacement-on-failure or even with a like-for-like replacement at the end of an RTU's useful service life. Additionally, opting for HP RTUs instead of the traditional AC RTUs may be better aligned with an organization's sustainability and greenhouse gas emissions (GHG) reduction goals.

As part of the Commercial Building Heat Pump Accelerator, the Commercial Building Heat Pump Campaign aims to help commercial building owners and operators reduce GHG emissions and operating costs by increasing the adoption of both existing and emerging heat pump technologies. DOE will provide building owners and operators with resources and guidance to deploy heat pump technology to support site- and portfolio-level installations. This document is one of these resources and highlights the key elements to consider for commercial building portfolio owners when deciding whether adopting HP RTUs for a site is the way forward. These considerations include:

- Climate Zone/Geography
- Cost and Utility Bill Impact
- Emissions Impact
- Building Type
- Equipment Availability
- Infrastructure
  - Electrical capacity
  - Physical constraints
  - Gas lines
- Contractor availability and knowledge
- Incentives

This document also provides building portfolio owners with a checklist encapsulating the key elements from the considerations. Based on the responses to the checklist, they can evaluate whether it would be suitable for their facilities to switch to HP RTU technologies (dual fuel HP RTUs, all-electric HP RTUs, or cold climate HP RTUs) described in Figure 1.

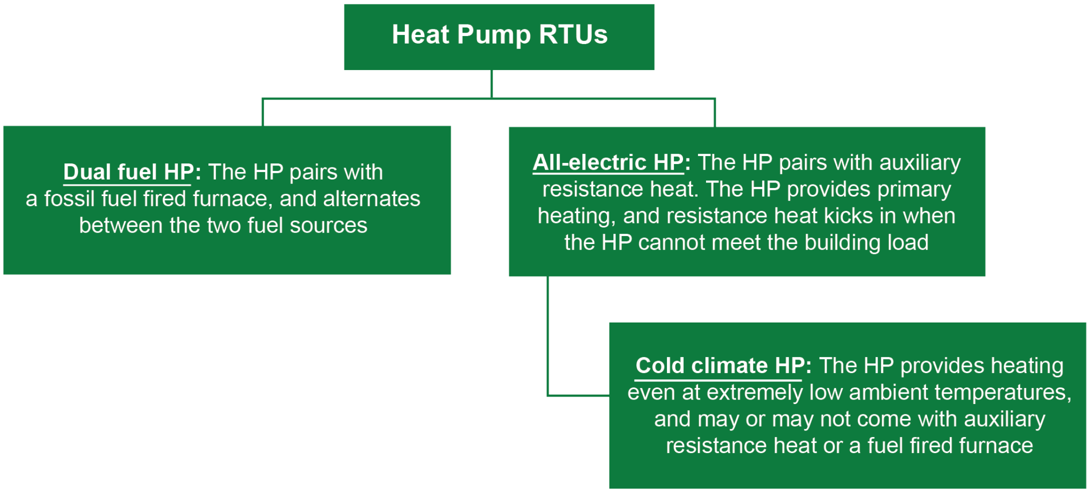


Figure 1. Types of HP RTUs

Key Considerations

A. Climate zone/geography

The decision to adopt heat pump RTUs can be greatly influenced by the building's location, and some buildings within an organization's portfolio may be better suited for HP RTU adoption than others. In particular, the climate zone and geography of the building's location can determine the appropriateness of going to an all-electric solution or dual-fuel solution.

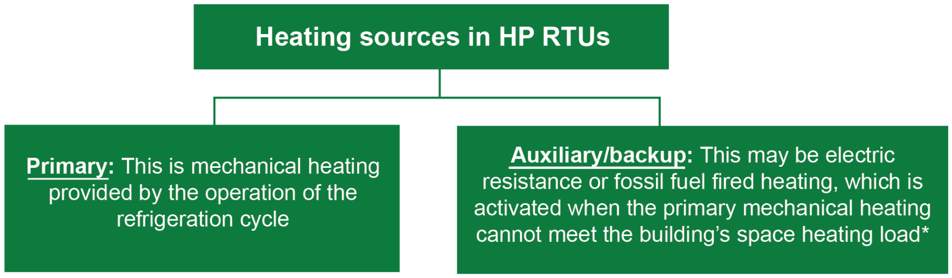
The building's location is a major factor in driving the building's space heating loads, local electricity and gas prices, and electrical grid emission factors.[1] The latter two can be used to model whether the location is projected to save on utility bills (see Section B) or reduce GHG emissions (see Section C).

Virtually all regions in the U.S. require some form of heating during the winter season. Traditionally, southern climates have experienced mild winters, but as evidenced by recent cold snaps in Texas (February 2021[2]), even southern climates can experience periods of sharp winter heating demand.

As outdoor temperatures drop, HP heating efficiency decreases and trends toward parity with electric resistance heating. Therefore, HP RTUs are best suited for mild-to-moderate winter heating, where they are most efficient. For most of the U.S. South and West regions, today's HP RTUs are an appropriate solution and fully capable of addressing most or all of the winter heating demand. In these regions, locations with low electricity prices and clean emission grids are the most suited for HP RTU adoption, as they are likely to yield utility bill savings and emissions reduction.

[1] The Grid Emission Factor (GEF) measures the amount of carbon emissions per unit of electricity (tCO_2/MWh) generated. The values of GEF for each state in the US are published by EIA at: [State Carbon Dioxide Emissions Data - U.S. Energy Information Administration (EIA)]

[2] *See:* The Great Texas Freeze: https://www.ncei.noaa.gov/news/great-texas-freeze-february-2021



* For most all-electric and cold climate HP RTUs, the electric resistance heat comes on during the defrost cycle, to heat the conditioned space, while the refrigeration cycle reverses direction to heat the outdoor coil

Figure 2. Types of heating sources in a HP RTU

Locations with moderate-to-extreme winters with consistent temperatures below 20°F (i.e., parts of the U.S. Northeast and Midwest) may not be an ideal fit for a traditional all-electric HP RTU. These locations may require specialized HP RTUs – either a cold climate HP RTU, which is capable of maintaining efficient performance at lower temperatures, or a dual fuel HP RTU that combines electric HP heating with gas/propane backup heating. These solutions are expected to have higher initial costs, but depending on the organization's cost and emission goals, they may be an appropriate choice.

Takeaways

- Building location determines space heating requirements, local electricity and gas prices, and grid emission factors
- U.S. South and West regions are best suited for HP RTU adoption due to cheaper electricity and milder climates
- U.S. Northeast and Midwest may require specialized solutions to tackle harsh winter – either cold climate or dual fuel HP RTUs

B. Cost and Utility Bill Impact

Cost is a central concern for most organizations when considering a shift to newer all-electric space conditioning solutions. "How much will it cost?", "How much will we save?", and "What is the payback period?" are often the top-of-mind questions. While upfront costs (cost to buy and install new equipment) and operating costs (cost to run equipment, i.e., electricity and gas utility bills) are better understood, it is essential to do a more holistic evaluation of costs via a lifecycle cost analysis. Such an analysis yields measurable performance metrics like "payback" period or return on investment (ROI) and allows for a long-term view of making investments in all-electric building technologies infrastructure.

For organizations that are strictly focused on upfront costs, a move to HP RTUs will be more challenging unless some of the cost is absorbed by government or utility incentives (see section H). Because HP RTUs can provide more efficient cooling and heating than AC-RTUs, they are generally priced at a higher premium than traditional offerings of similar capacity and efficiency.

For organizations more focused on operating costs (utility bills), HP RTUs are likely to reduce overall energy usage due to their more efficient heating operation. However, whether this reduced energy usage will lead to cost savings depends on the local electricity and fuel prices. Locations where electricity-to- gas price ratios[3] are relatively higher than the national average (~1.2[4]) may not yield an operating cost benefit because inefficient fuel-fired heating may still come out to be less expensive to operate than efficient HP heating. Such is the case in most Midwest and Northeast states, where electricity: gas price ratios range from 1.27-1.95. On the other hand, most Southern states and the Pacific Northwest have electricity: gas price ratios which are more favorable for electric HP heating – ranging from 0.8-1.15. Buildings in these states are likely to deliver operating cost benefits when using HP-RTUs.

Organizations that review lifecycle costs are likely to be interested in measuring the success of their investments, either through payback period analysis or measuring ROI. In some instances, HP RTUs may not yield a payback across the useful lifetime of the equipment. This is most likely in locations where electricity is much more expensive than gas. In other cases, a payback period or ROI% may be achieved but may not meet the requirements of the organization. In such cases, depending on the priorities of the organization, i.e., cost focus or emissions reduction focus, the organization may choose to continue with HP RTUs or stick with more traditional options.

Figure 3 shows a plot of the modeled operating costs for a variety of commercial buildings, simulated as part of the National Renewable Energy Laboratory's (NREL) commercial building sector stock model ComStock[5], across nine key locations across the U.S. for two scenarios, namely, (1) all-electric variable speed HP RTU with electric resistance backup, and (2) dual fuel variable speed HP RTU with natural gas backup, in comparison to the baseline, which is a standard AC RTU with natural gas heating. The variety of commercial buildings and locations allowed for capturing variations in climate, grid emission factors, and utility rates. As an example, it can be seen that the utility bill savings may be as high as 27% for schools in San Francisco for all-electric HP RTUs, but the same unit would result in negative savings of 25% in Minnesota, due to a difference in their building heating loads, how "clean" the current electrical grid is, and the cost of electricity.

[3] Ratio of state average electricity prices in cents/kwh to natural gas prices in $/MCF (cents per kWh / $ per MCF)

[4] As evaluated using EIA data. Natural gas prices: https://www.eia.gov/dnav/ng/ng_pri_sum_a_EPG0_PRS_DMcf_a.htm ; Electricity prices: https://www.eia.gov/electricity/state/

[5] ComStock is a U.S. DOE model of the commercial building stock, developed and maintained by NREL. Data and documentation are available at: https://comstock.nrel.gov/

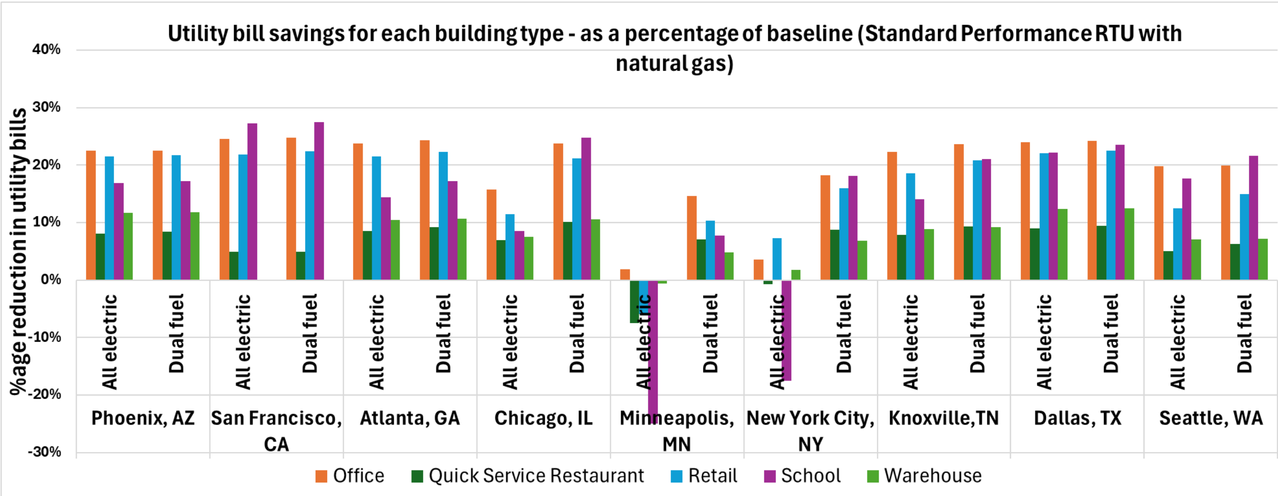


Figure 3. Utility bill savings of HP RTU upgrades in comparison to baseline space cooling and heating system.

Takeaways

- When focused solely on upfront costs, a switch to HP RTUs will rarely make sense for organizations due to the increased premium associated with higher efficiency equipment
- For organizations focused on operating costs, utility bills savings will depend depends on the local electricity and fuel prices
- Instead of only focusing on upfront or operating costs, it is essential to do a more holistic evaluation of costs via a lifecycle cost analysis – which provides metrics such as payback/ROI to make informed decisions.

C. Emissions impact

With an increase in state and federal government regulations surrounding building emissions reductions[6], many organizations are actively pursuing their own decarbonization goals. Since roughly half of building energy use is tied to cooling and heating needs[7], electrification of space conditioning is a key means to reduce emissions.

Replacing a traditional gas-fired RTU with either an all-electric HP RTU, dual fuel HP RTU, or an all-electric cold climate HP RTU, can substantially decarbonize the building`s footprint. The shift to the type of HP RTU will depend on the organization`s specific decarbonization goals, the local climate, and how clean the electric grid is in the region.

[6] An example is President Biden`s Executive Order 14057, referred to as the "Federal Sustainability Plan", establishes a pathway to achieve net-zero emissions in buildings by 2045. Source: Net-Zero Emissions Buildings by 2045, including a 50% reduction by 2032 | Federal Sustainability Plan | Office of the Federal Chief Sustainability Officer

[7] 2018 Commercial Buildings Energy Consumption Survey, prepared by the US Energy Information Administration (EIA). Source: PowerPoint Presentation (eia.gov)

Generally, all three options (HP RTU, dual fuel HP RTU, cold climate HP RTU) will provide an emissions reduction benefit in most locations in the U.S. when compared to a traditional RTU. Buildings located in milder climates and with "clean"[8] electric grids (for example, the Pacific Northwest) will see the highest emissions benefits.

For a building located in a cold climate and with a "dirty" electric grid (where the majority of the electricity is produced from fossil fuels) , a dual-fuel HP RTU may be a better fit. Electric HP heating can address the milder portion of the heating requirement (typically when outdoor temperatures are above 20°F), which is more efficient, and the fuel-fired backup can take over during the more extreme portions of the heating. Alternatively, for a building located in a cold climate but with a clean grid, an all-electric cold climate HP RTU may deliver the most emissions benefit. A cold climate HP RTU ensures efficient performance even at very low temperatures and can address most of the heating needs in the season without auxiliary resistance heat[9].

Figure 4 shows a plot of the modeled reductions in GHG emissions for the same building types, locations, and scenarios shown in Figure 3, using NREL`s ComStock tool. It can be seen that emissions savings are highly correlated with the type of commercial building, followed by its location.

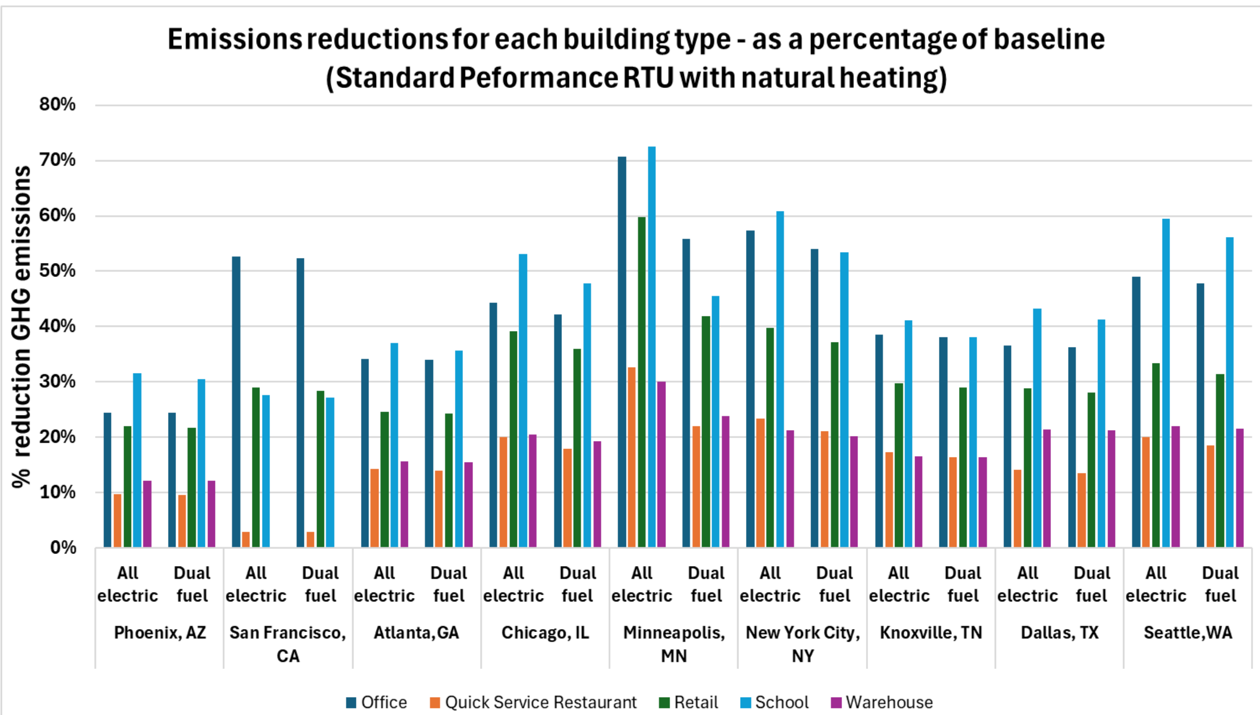


Figure 4. GHG emissions reductions of HP RTU upgrades in comparison to baseline space cooling and heating system

[8] Clean is a relative term to indicate electric grids that have a high share of renewables in the grid mix, resulting in a low grid emissions factor

[9] Electric resistance heat can come on during defrost or when there is a brief period of extremely low ambient temperatures.

Takeaways

- The GHG emissions benefits from an HP RTU solution depend on the grid emission factors, building location/climate, and the organization`s decarbonization goals
- Generally, all three options (HP RTU, dual fuel HP RTU, cold climate HP RTU) will provide emissions reduction benefits in most locations in the US when compared to a traditional RTU
- All-electric HP RTUs will be suitable for locations with a clean electricity grid
- Dual fuel HP RTUs will be suitable for locations with an electricity grid primarily served by fossil fuels

D. Building Type

Commercial buildings come in all shapes and sizes and serve a variety of purposes. How a building is utilized plays a pivotal in deciding what space conditioning services are required and what systems are suitable. Office buildings are typically set up to control for human comfort based on a set weekday schedule. Alternatively, warehouses are often controlled to operate within a narrow temperature range to maximize the shelf life of stored goods or to prevent freezing since human occupancy is limited.

RTUs are a reliable solution suitable for many building types - especially low- to mid-rise buildings with flat roofs and ductwork. When deciding if HP RTUs are suitable for a particular building type, certain aspects of conditioning need to be taken into consideration. Ventilation, peak loads, schedules, and human vs. non-human comfort all play key roles in the decision-making process.

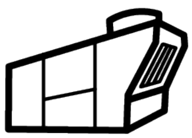
Analysis using NREL`s ComStock data suggests that HP RTUs deliver the highest operating cost benefits in office and small retail buildings. These building types generally have consistent space conditioning needs and schedules, making them ideal for efficient HP-RTUs to deliver savings.

For building types such as schools, which require increased ventilation and rapid recovery of temperature during morning ramp-up periods (e.g. heating on a cold day), HP-RTU savings may be lower. For colder climates where conditioning outside ventilation air is energy intensive, and the difference between outdoor and return air temperatures is high, fuel-fired heating may be less costly than HP heating. Buildings where heating requirements are limited, such as warehouses, may also see limited HP-RTU savings because the benefit of efficient heating is not fully realized by the shorter seasonal runtimes and baseline energy consumption.

Takeaways

- Certain aspects of conditioning – such as ventilation needs, peak loads, schedules, human vs. non-human comfort, are key factors to consider in determining HP RTU suitability
- HP RTUs deliver the highest operating cost benefits for building types that have consistent space conditioning needs and schedules – such as offices and small retail.
- Buildings that require increased ventilation (schools) or where heating needs are limited (warehouses) may see lower HP-RTU savings

E. Equipment Availability



The decision to switch to HP RTUs may depend on the age of the organization's current RTUs. If the current RTUs have been recently purchased, then the organization may choose to delay replacing them with dual fuel or all-electric options based on the organization's decarbonization goals and budget.

When considering HP RTUs as a replacement, it is critical to be proactive and not reactive. Since HP RTUs are still considered premium equipment, they may not be readily available off-the-shelf or will likely have a limited off-the-shelf selection. Therefore, switching to HP RTUs during an emergency replacement is typically not ideal.

An organization should create a procurement plan and allow for plenty of lead time to research the available HP RTU options. The most efficient HP RTUs are custom built-to-order units requiring longer lead times. Organizations may need to engage with different vendors and contractors to decide the appropriate HP RTU type and the manufacturer most suited to their needs.

An organization may also prefer to work with a particular Original Equipment Manufacturer (OEM). Careful evaluation is needed to ensure that the preferred OEM has HP RTU offerings that meet the needs of the building. Factors such as capacity, seasonal efficiency, heating performance, maintenance at lower temperatures, and switchover temperature[10] are some of the key technical aspects to consider and compare when procuring from an OEM.

Takeaways

- When considering HP RTUs as replacements, it is critical to be proactive and not reactive.
- An organization should create a plan for procurement and allow for plenty of lead time to research the available HP RTU options
- Particulars like capacity maintenance, seasonal efficiency, heating performance, and switchover temperature are some of the key technical aspects to consider and compare when procuring from an OEM

[10] The ambient temperature at which the heat pump cannot heating load in the building, causing the unit to switch to either natural gas heating (dual fuel HP RTUs), efficiency, or electric resistance heating (all-electric HP RTUs)

F. Infrastructure

1. Electrical capacity

When replacing a traditional RTU with an all-electric HP RTU, upgrades to the electrical infrastructure may be required to accommodate the increased electric load for the HP heating. This increase in electric load can be substantial, especially for buildings in cold climate regions, where auxiliary heat may be required to supplement the HP heating, where more wiring and power draw is needed for the auxiliary resistance heat coils and the auxiliary resistance heat kit[11].

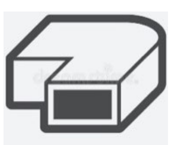
If spare electrical capacity does not currently exist in the building, the organization will need to evaluate the cost of panel upgrades for their building. Depending on the local electrical code, the organization may need to involve the local utility to upgrade the electrical service to the building.

Additionally, even if there is spare electrical capacity in the building, the organization would need to ensure that it is not reserved for any other decarbonization projects or expansion projects. These could include water heating, space cooling equipment, or chargers for electric vehicles (EVs), which would require new electrical connections.

Takeaways

- HP RTUs may lead to an increased electrical load on the building
- Organizations would need to ensure that spare electrical capacity is available to accommodate the increased load requirements of the new HP RTUs

2. Physical Constraints



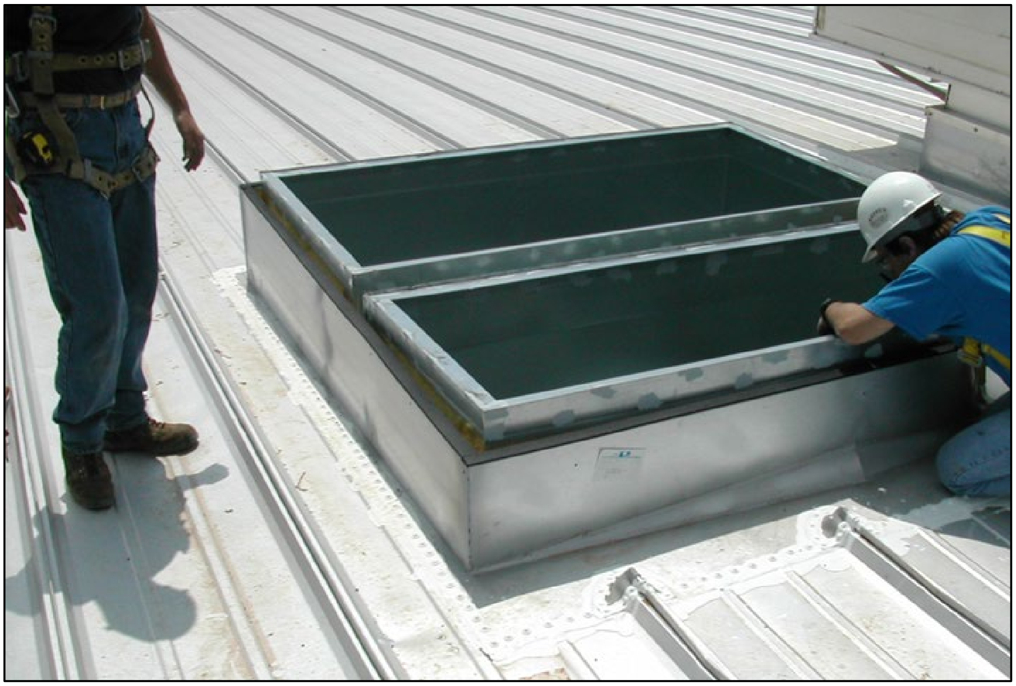
A dual fuel or an all-electric HP RTU may have different dimensions and weight when compared to the traditional RTU they will be replacing. This is because some of the components inside HP RTUs may be different than standard RTUs, such as an additional heat exchanger for an HP equipped with enhanced vapor injection (EVI)[12].

An organization would need to first identify if the new HP RTU is replacing only an AC RTU (just providing cooling), or an RTU that provides heating with gas or electric resistance. They would then need to evaluate if a larger curb is needed on the roof to accommodate the new dual fuel or all-electric HP RTU. If the new dual fuel or electric HP RTUs are heavier than the RTUs they are replacing, then any structural upgrades that are needed for the roof would need to be identified as well. Many newer rooftop units have larger footprints than older models and may require roof curb redesign or structural supports to accommodate the larger size and weight.

[11] This assessment has to be carried out by the electrical contractor
[12] Enhanced Vapor Injection (EVI) is a method of increasing the temperature gap between the evaporator (cooling coil) and condenser (heating coil) in heat pumps, in order to provide a higher heating capacity and higher system COP, in comparison to a conventional refrigeration cycle

What is a Rooftop Unit Curb?

To have ample structural support, RTUs need to be placed on top on platforms called curbs. Curbs are custom-sized and spaced to accommodate the RTU's weight and center of gravity for optimum vibration dampening. RTU manufacturers usually offer equipment that fits on one or more standardized curb sizes.



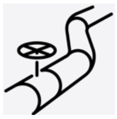
Additionally, when replacing a fossil fuel-fired heating system with an all-electric HP RTU, there may be a need to redesign the ducting in the building that provides conditioned air in case the design airflow rates for the HP RTU are different than those of the fossil fuel-fired heating system. This is because the supply air temperatures are different for fossil fuel-fired systems and HP (mechanical) systems.

Another consideration to note is whether the move to HP RTUs is part of a larger decarbonization effort by the organization - there may be a need to install other equipment on the roof, such as solar photovoltaic (PV) panels. Therefore, it is important to evaluate any space constraints that exist for the replacement HP RTUs.

Takeaways

- HP RTUs may have different dimensions and weight compared to existing RTUs, thereby requiring curb re-design and/or structural upgrades
- If HP RTU replacements are part of a larger decarbonization effort, rooftop space may be constrained and may need to be prioritized

3. Gas lines



When installing dual fuel or all-electric HP RTUs, an important consideration is the availability and/or decommissioning of any gas lines.

For retrofit projects in existing buildings where standard gas fired RTUs are being replaced with all-electric HP RTUs, there may be natural gas lines that need to be decommissioned and removed. This cost would need to be accounted for by the organization.

For new buildings, if the organization is considering dual fuel HP RTUs (with gas backup), it is imperative that a gas connection is available in the building and can be extended to the roof. The organization will have to work closely with the gas utility company and contractors to obtain relevant permits. The cost associated with the extension will depend on the proximity to the gas pipeline and other relevant utility connection costs.

Takeaways

- HP RTU replacements in existing buildings would require accounting for costs for decommissioning of natural gas lines
- If installing dual fuel HP RTUs in new buildings, gas connection/extension costs may be incurred

G. Contractor Availability and Knowledge

The successful deployment of HP RTUs as an electrification solution requires an available and knowledgeable contractor team. Designing, installing, commissioning, and maintaining HP RTUs to ensure that this equipment can perform as efficiently as possible and deliver its anticipated performance.

HVAC contractors are often the bottleneck in HP deployment – there is a general shortage of available skilled trades workforce in many regions, especially contractors comfortable working on HP equipment. Some contractors may also have preconceived skepticism of HP equipment and might prefer installing traditional RTUs as opposed to newer HP technologies.

Many medium-to-large organizations employ in-house HVAC staff to maintain and install equipment. If the organization's preference is to utilize in-house contractors to install HP RTUs, their familiarity with newer HP technologies should be gauged beforehand.

If contracting outside the organization, the choice of contractor is key. Contractors that have previously worked on HP RTUs should be preferred – they are less likely to charge a 'risk tax' than contractors who do limited HP RTU installs and therefore, are less comfortable with them.

What is a Risk Tax?

While HPs are not new equipment, they are often perceived as new and consequently, “risky”. They also have a few more moving parts as opposed to traditional AC units.

Contractors may hedge the perceived risk associated with HPs by charging more to install them (as compared to AC units). This is the ‘risk tax’ that then gets passed on to the consumer or organization.

Takeaways

- Installing, commissioning and maintaining HP RTUs is a critical element in ensuring that this equipment can perform as efficiently as possible
- There is limited availability of knowledgeable contractors with experience in installing HP equipment
- Whether opting to use in-house staff or contract external workforce – choosing a contractor well versed in installing HP equipment is key to avoid a ‘risk tax’.

H. Incentives

Efficient HP RTUs may be eligible for incentives that may greatly improve their cost outlook. In particular, organizations that are often deterred by the higher upfront cost of HP RTUs may offset this cost by utilizing potential incentives offered by the government, efficiency organizations, and utilities.

Government incentives can exist at the federal, state, county, and city levels. Generally, federal incentives are offered as tax credits, while other government incentives may be tax credits or rebates. In some cases, low-cost financing of equipment may also be offered.

Many electric utilities and state energy efficiency programs offer financial incentives and rebates to support the installation of high-efficiency RTUs. In some cases, utilities offer additional incentives for early replacement and fuel-switching projects. For complex projects or technologies that are not listed in the incentive programs, the organization should communicate with the energy efficiency program to understand the custom application process. Furthermore, electric technologies can participate in demand response and load flexibility programs, particularly those technologies that utilize HP systems. Utility rebates are often based on the Consortium of Energy Efficiency (CEE) Tier standards. Rebate programs typically pay customers around $30 per ton for high-efficiency units larger than 65,000 Btu/h.

A collection of government and utility energy efficiency incentives can be found here: link

Takeaways

- Efficient HP RTUs may be eligible for incentives that may greatly improve their upfront cost outlook
- Incentives are available from the government, utilities and efficiency organizations. They can be in the form of tax credits, rebates or cheap financing
- A collection of government and utility energy efficiency incentives can be found here: **link**

Conclusion

Several considerations factor into the decision to adopt heat pump RTUs. Organizations interested in HP RTUs are advised to review these considerations prior to making decisions. As a summary of the considerations discussed above, the next section provides a checklist of key questions that will help organizations determine the suitability of adopting HP-RTUs.

Organizations interested in HP RTUs, and any stakeholders interested in HP RTUs in general are encouraged to look at other resources developed by the Commercial Building Heat Pump Campaign, available online at https://betterbuildingssolutioncenter.energy.gov/commercial-bldg-heat-pump/campaign. Additionally, they may reach out to betterbuildings@ee.doe.gov, for any other questions or concerns.

Summary Checklist

This summary checklist is intended to provide a rough quantitative gauge of whether HP RTUs are suitable for your organization. All "yes" answers in the checklist should be tallied and matched with the key below to assess suitability.

Theme	Description	Yes	No	N/A
Location and Use	○ Is the building located in a climate zone suitable for an all-electric HP solution?	☐	☐	☐
	○ Are there emissions and utility bill savings projected in this location?	☐	☐	☐
	○ Is the building type suitable to pursue an all-electric HP solution?	☐	☐	☐
Cost	○ Are electricity and fuel rates favorable to move towards an all-electric solution?	☐	☐	☐
	○ Is the organization willing to forgo upfront and operating costs concerns in favor of a lifecycle view?	☐	☐	☐
	○ Does a lifecycle cost analysis show a reasonable payback/ROI?	☐	☐	☐
	○ Are government and/or utility incentives available to offset upfront costs?	☐	☐	☐
Emissions	○ Does the organization have emission reduction goals?	☐	☐	☐
	○ Does the organization prioritize emissions reductions vs. costs?	☐	☐	☐
	○ Are the local grid emission factors favorable to achieve emissions reductions?	☐	☐	☐
Equipment and Contractor	○ Is the identified HP equipment available, or will it be available in a reasonable timeframe?	☐	☐	☐
	○ If in-house staff will install equipment – has staff knowledge on HP installations been assessed?	☐	☐	☐
	○ If an external party will install equipment – does the contractor have prior experience with HP installations?	☐	☐	☐
Infrastructure	○ Is spare electrical capacity available?	☐	☐	☐
	○ If spare electrical capacity is unavailable, are electrical upgrades feasible and within budget?	☐	☐	☐
	○ Existing buildings - if switching to all-electric, has the gas line been decommissioned?	☐	☐	☐
	○ New buildings - if opting for dual fuel, is a gas connection available?	☐	☐	☐

	○ Would the existing curb suffice for the replacement equipment?	☐	☐	☐
	○ Is the existing ductwork adequate for the new equipment or is remodeling required?	☐	☐	☐
	○ Is the existing rooftop structure capable of supporting the weight of new equipment?	☐	☐	☐

Key	
Count of "Yes"	**HP RTU Suitability**
0-5	Not suitable
5-10	Maybe suitable in exceptional cases
10-15	Suitable
15-20	Very suitable