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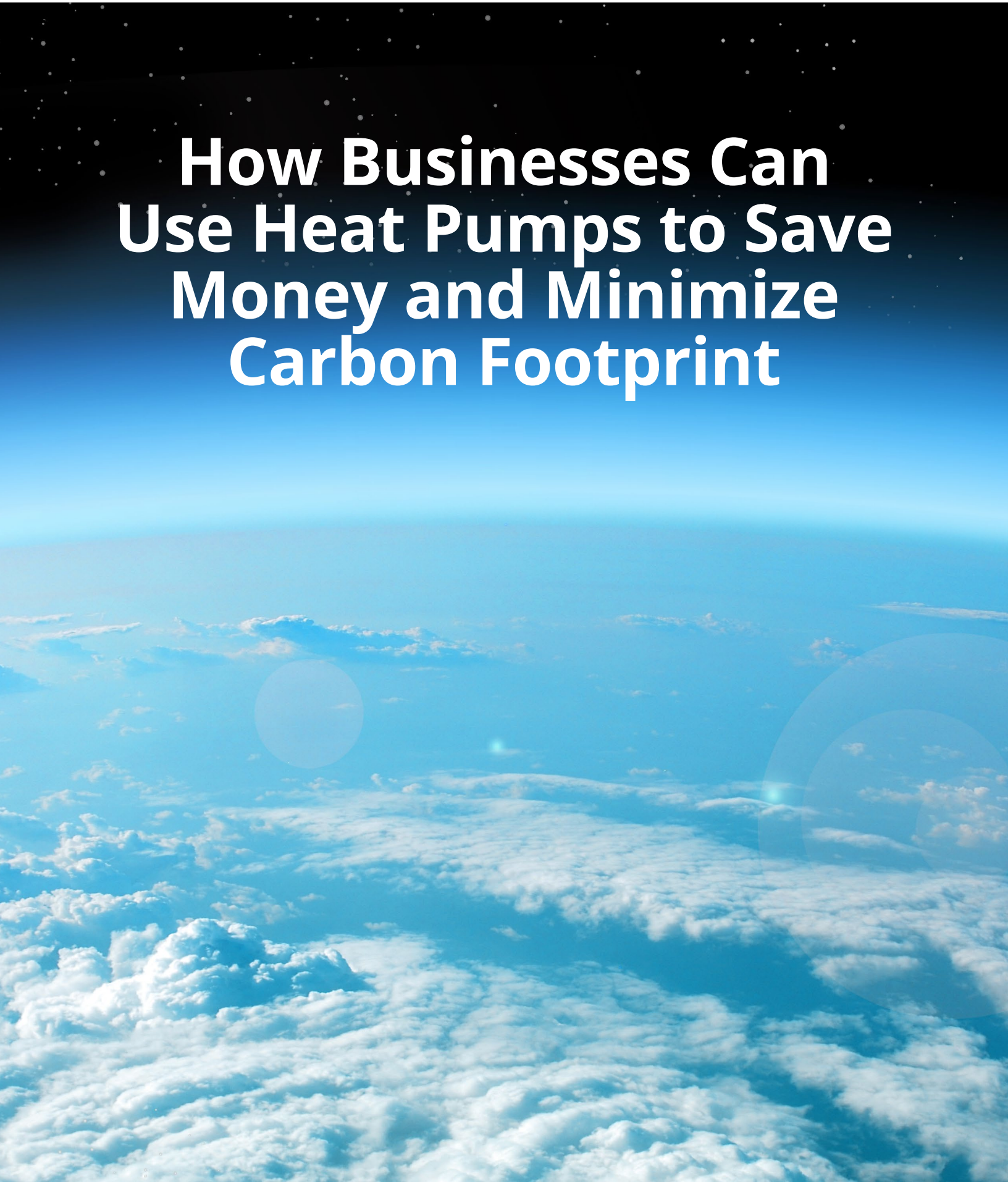
How Businesses Can Use Heat Pumps to Save Money and Minimize Carbon Footprint



Energy is a significant expense for stores, schools, offices, hospitals, and other commercial buildings, which spend about $141 billion annually on electricity and natural gas, according to the U.S. Energy Information Administration's most recent *Commercial Buildings Energy Consumption Survey*. Although lighting and IT systems might seem like the biggest energy consumers, heating is actually No. 1, at 32%, with another 9% for cooling.

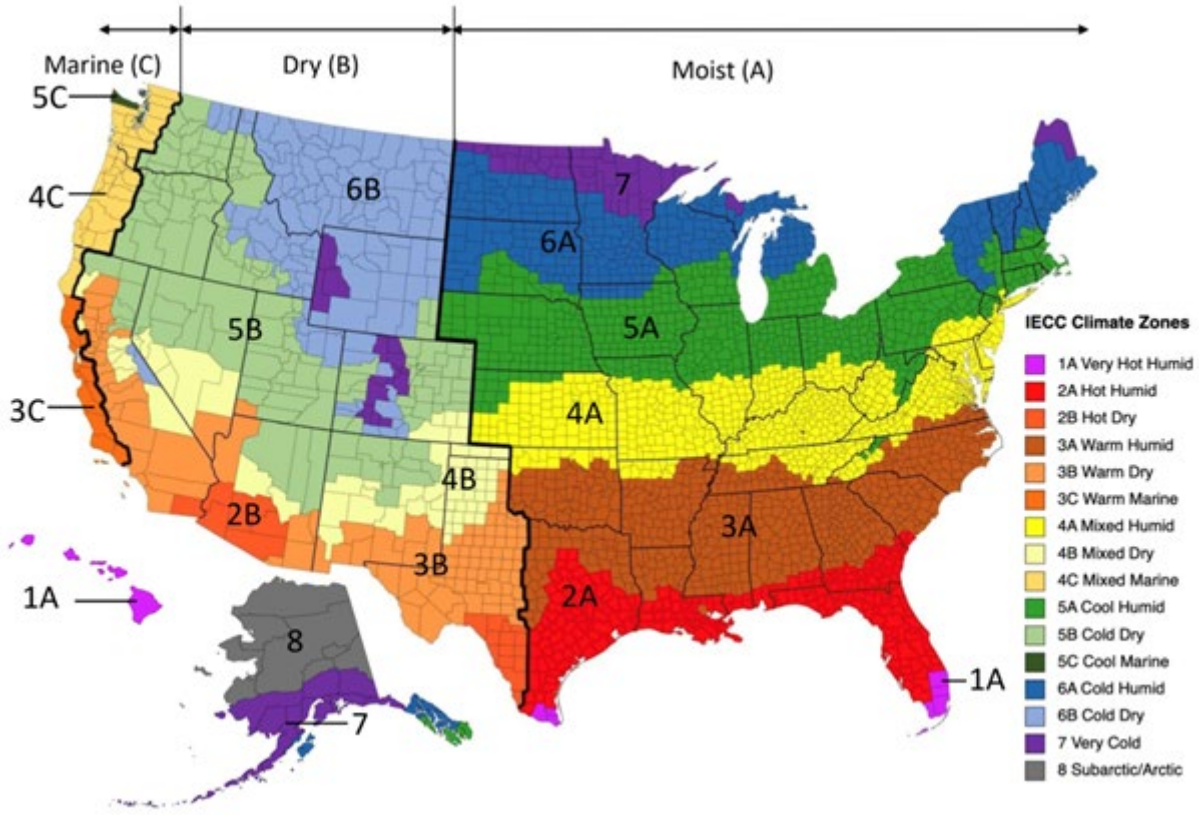
Those figures highlight a major reason why commercial building owners are increasingly implementing heat pumps: They can provide heating and cooling much more efficiently than alternatives such as furnaces, boilers, and air conditioners — even in cold climates such as the northeastern United States.

Another reason is that heat pumps enable businesses to maximize their usage of electricity from renewable resources such as wind, solar, and hydro. That makes them an ideal way to meet their sustainability goals, as well as achieve green building certifications such as LEED Gold and Platinum. "Momentum to electrify building heat is accelerating, as investors, tenants, and regulators in many markets press for decarbonization," McKinsey & Company says. "In response, building owners are increasingly exploring heat pumps as an energy-efficient, cost-effective solution."

A third reason is that reducing consumption of natural gas and other fossil fuels can qualify building owners for a wide variety of tax credits and other incentives from federal, state, and local governments. "Heat pump rooftop units (RTUs) are estimated to reduce greenhouse gas (GHG) emissions and energy costs by up to 50% compared with conventional RTUs (with natural gas heating)," the U.S. Department of Energy (DoE) says.

If you're a mechanical engineering manager, systems designer, facility engineer, or facility manager for a big box retailer, strip mall, school, or one- or two-story office building, read on to learn:

- How heat pumps are used for both heating and cooling.



- How businesses, school districts, and other organizations can use today's heat pumps to meet their sustainability goals, including LEED certifications.
- Why next-generation cold-climate heat pumps will be a viable option in places where the ambient outdoor temperature dips as low as 0°F, making them superior to the traditional heat pumps on the market today.
- What businesses are saying about their heat pump plans and implementations, and how they're partnering with the HVAC industry to develop cold-climate heat pumps.
- What to consider in terms of the grid, electrical upgrades, operating costs, and building management system (BMS) integration when developing a heat pump strategy.

HOW HEAT PUMPS WORK

Unlike air conditioners and furnaces, heat pumps provide both heating and cooling. When cooling is required, heat pumps operate like air conditioners by removing heat inside the building and transferring it outdoors. When heating is needed, the heat pump reverses this cycle by collecting heat from the outdoor air and transferring it indoors.

This type of heat pump is known as "air source" because the transfer occurs in the air, unlike geothermal models, which use underground piping to create an exchange of heat from the ground to the refrigerant system. Air-source heat pumps avoid geothermal construction time and expenses related to trenching through parking lots and landscaping to bury piping that is used as the below-grade heat exchanger.

In colder climates such as the central Midwest, heat pumps often have an auxiliary heating system that kicks in when outdoor temperatures dip below what is called the balance point. Auxiliary systems are typically traditional sources of heat, such as electrical strip heaters or gas furnaces.

In the future, cold-climate heat pumps will be designed to operate and deliver more heating capacity at even lower ambient temperatures. This makes them viable for use in colder climates, which can be defined geographically as Zones 4 through 7 in the International Energy Conservation Code (IECC) map.

WHY HEAT PUMPS ARE INCREASINGLY VIABLE AS A PRIMARY HEAT SOURCE

Heat pumps are a mature, proven technology that is continually advancing in ways that make it viable for even more commercial applications, from schools to office buildings to big-box stores. Advances in heat pump technology and efficiency are making their use as a primary heating source more attractive.

"Building heat has typically been a challenge to electrify at scale because of the high cost and complexity of converting a wide variety of current heating systems (steam, hot water, forced air, to name a few), as well as the relative cost-effectiveness of fossil-fuel energy sources in most cold weather population centers," McKinsey & Company says. "However, electric heat pumps have become an increasingly effective way for buildings to decarbonize due to operating, equipment, and installation costs becoming more competitive in certain markets, as well as developments in heat-pump technology."

Heat pumps are key for expanding commercial adoption geographically and, in the process, helping municipalities, states, and the country reduce carbon emissions. "Fewer than 15% of commercial buildings in the U.S. currently have heat pumps," the DoE says. "Heat pump adoption is even lower in cold climates, where the performance and availability of commercial building equipment lags behind residential systems."

> ***"...electric heat pumps have become an increasingly effective way for buildings to decarbonize due to operating, equipment, and installation costs becoming more competitive in certain markets..."***
>
> — McKinsey & Company

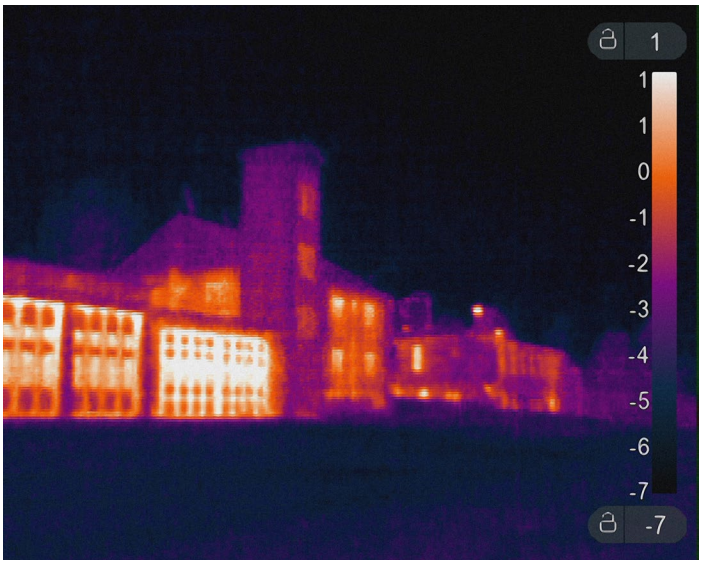
Many businesses are considering heat pumps due to regulatory changes, lower operating costs in some climate zones, and their sustainability goals.

"Bans on gas connections to new buildings are being implemented in several areas," McKinsey & Company says. "Several U.S. cities have banned gas connections to new buildings as well, including Berkeley, California, in 2019 and New York City in 2021. In New York City, Local Law 97 requires an 80 percent reduction in emissions intensity over the next 30 years for large multifamily and commercial buildings, with annual fines

beginning in 2024 and increasing in 2030 for exceeding emissions caps."

Another example is New York State, the first in the nation to ban natural gas for heating and appliances. It takes effect in 2026 for most new buildings under seven stories and then expands to taller ones starting in 2029.

These regulatory changes are also driving heat pump adoption by owners of multi-dwelling units (MDUs) such as apartment buildings and condominiums. That adoption indirectly benefits school districts, big box retailers, and other businesses by helping drive heat pump technology innovation across the board.



HOW MAJOR BUSINESSES ARE ACCELERATING COLD-CLIMATE HEAT PUMP TECHNOLOGY ADVANCES

In April 2024, the DoE announced the Better Buildings Commercial Building Heat Pump Accelerator, where Lennox and other manufacturers "will produce higher efficiency and life cycle cost-effective heat pump rooftop units and commercial organizations will evaluate and adopt next-generation heat pump technology. … The Accelerator aims to bring more efficient, affordable next-generation heat pump rooftop units to market as soon as 2027— which will slash both emissions and energy costs in half compared to natural gas-fueled heat pumps. If deployed at scale, they could save American businesses and commercial entities $5 billion on utility bills every year."

The DoE Accelerator program follows the successful model of its Cold Climate Heat Pump Technology Challenge for the residential market. Launched in 2021, the Challenge has two categories: Residential cold-climate heat pumps that can operate at 5°F and those that can operate at -15°F. Both types must be able to provide 60,000 BTU per hour without the use of auxiliary heat. As a Challenge participant, Lennox pioneered residential cold-climate heat pumps and is now applying that expertise to commercial units.

One reason why the residential cold-climate heat pump market developed first is because home systems are 5 tons or less. Commercial applications require much larger compressors and thus more power, which creates challenges such as the local electric utility having insufficient capacity. Electrical service upgrades can take years to budget and implement and often do not align with planned equipment or emergency replacement schedules and budgets. Having heat pump options that can be installed on existing electrical services is critical to broad customer adoption. But, as discussed later in this paper, businesses have several options for overcoming these challenges to keep their cold-climate heat pump projects on budget and on schedule.

Major businesses such as Amazon, IKEA, and Target helped develop the Better Buildings Commercial Building Heat Pump Accelerator program and are now active participants. Their role is key in ensuring that new heat pump technologies meet end-user

requirements. It also highlights how major businesses already see value in both traditional heat pumps and next-generation cold-climate models. For example, in a DoE webinar, Target said it "deploys heat pumps in warm climates and select cold climate new buildings with sufficient electric service size."

For years, many businesses, school districts, and other commercial building owners have considered traditional heat pumps and decided that they weren't viable for their climate. Today, with companies such as Target exploring and implementing heat pumps, now is an ideal time to take a fresh look at heat pumps in general because advances in technology have expanded their geographic viability, energy efficiency, and ability to achieve sustainability goals.

HOW TO DEVELOP AND EXECUTE A SUCCESSFUL HEAT PUMP IMPLEMENTATION STRATEGY

When deciding where, when, and how to implement heat pumps, it's important to recognize that the overarching electrification trend is not limited to commercial and residential heating. The installed base of commercial and passenger electric vehicles is also growing due to similar incentives. Heating, cooling, and EVs are among the major reasons why electric utilities are struggling to accommodate soaring demand. Some factors are outside their control, such as the lengthy process of applying for the permits and zoning necessary to add substations and feeder lines and a post-pandemic shortage of infrastructure such as breakers.

Businesses must understand these challenges and develop strategies to ensure that they don't become roadblocks to their heat pump implementations. For example, providing the power necessary to support

a commercial customer's heating system may take the local utility 12 to 18 months. This long lead time highlights the importance of assessing the local utility's capacity and roadmap early on during site selection for new construction and when identifying existing facilities that are candidates for heat pumps.

Some businesses are interested in heat pumps as a way to help meet goals such as reducing their carbon footprint and achieving LEED certifications, especially Gold and Platinum levels. Those goals can actually help overcome the challenge of insufficient local utility capacity.

For example, Whole Foods Market's Third and 3rd store in Brooklyn, NY, is a 55,000-square-foot building that includes a 324-kW solar canopy array. These types of onsite renewable energy infrastructure can be sized to support multiple heat pumps until the local utility can add capacity — or even permanently if the business wants to minimize its grid impact and reliance and carbon footprint. This highlights why businesses should consider how their heat pump strategy can leverage their renewable energy strategy.

Another key consideration is whether a new or existing building's electrical infrastructure has the capacity necessary to support heat pumps with auxiliary

electric heat designed to be operated concurrently with mechanical heating. Several Accelerator members participated in an Aug. 6, 2024, DoE webinar, "The Better Buildings Commercial Building Heat Pump Accelerator: Goals and Next Steps." For example, Target's presentation identified "existing building electrical services not sized for electric heat load in cold climates" as one of the application challenges.

Upgrading an existing building to support heat pumps and their auxiliary electric strip heat may require additional panels, breakers, cabling, and other electrical infrastructure. If it's new construction that uses a design built in other markets — as is the case with retail big-box stores — the electrical infrastructure design may need to be modified to support any additional electrical load.

Finally, many businesses are developing smart building strategies to help reduce utility bills, minimize their carbon footprint, achieve LEED certifications, and track their sustainability achievements. Look for opportunities to integrate heat pumps with building management systems (BMS) to support those goals. One example is using the BMS to coordinate heat pump usage to reduce the building's total peak load.

HOW TO GET STARTED

Today's heat pumps are a proven way to reduce the energy consumption and carbon footprint of schools, hospitals, stores, offices, and other large commercial buildings. Next-generation cold-climate heat pumps will expand those opportunities to even more commercial buildings, including those in places where the ambient outdoor temperature dips as low as 0°F.

Lennox is a pioneer driving innovation with heat pumps in the light commercial HVAC market. Lennox Commercial is committed to developing products that meet the evolving needs of the market, and we continuously strive to make all our products more sustainable.

Let's partner to create a more sustainable future.
To learn more and get started, visit lennoxcommercial.com.

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