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Make the shift from gas to electric water heating

Decarbonizing fossil-fuel boilers and water heaters with hydronic heat pumps and heat pump water heaters

COPELAND
Engineered for Sustainability

Abstract

Globally, the electrification of gas-fired water heating systems in commercial buildings is becoming a key environmental strategy to achieve decarbonization goals. In the U.S. regulatory climate, states concerned with meeting climate initiatives are leading the push to ban fossil-fuel-powered water heating, such as boilers used for hot water and water-based comfort heating.

Many commercial building owners are actively pursuing sustainability goals, driven by a combination of regulatory mandates, investor expectations, tenant demands and the financial benefits associated with operating energy-efficient properties.

Advancements in electric water heating (i.e., heat pump) technologies are reshaping a gas-dominant commercial water heating landscape. These heat pumps utilize readily available air, water and ground sources to transfer heat into hot water used for comfort heating or domestic hot water (DHW). Table 1 provides an overview of common "to-water" heat pump types and applications.

Sources, applications and considerations for electric water heaters and/or heat pumps

Type	Heat Source	Typical Applications	Considerations
AIR-TO-WATER	Outdoor air	• Radiant heat distribution • Fan coil heating and cooling • Domestic hot water (DHW) • Chiller replacement in mild climates	Most common retrofit option; performance is affected by ambient air temperature.
WATER-TO-WATER	Building loop or well water	• Central hot/chilled water plants • Hydronic heating/cooling with existing water loop • Domestic hot water	Ideal for buildings with existing water loops or access to thermal storage.
GROUND (GEOTHERMAL)-TO-WATER	Ground or groundwater	• Schools, offices, hospitals, and other high-use buildings • Radiant systems and fan coils • Combined heating and cooling loads	High efficiency and stable year-round performance; higher upfront cost, lower operating cost.

When combined with a grid composed of sufficient renewable energy resources, electric water heaters offer the potential to reduce energy consumption and decarbonize conventional water heating systems.

Due to the wide variety of commercial buildings, heating and cooling systems, climates, and occupancy requirements, specifying an electric water heater is not a one-size-fits-all proposition. Systems must be configured to meet specific installation requirements. Generally speaking, electric water heating technologies for commercial buildings encompass two primary types of heat pumps:

- **Hydronic heat pumps** offer year-round comfort heating and cooling, as well as a potential source for DHW.
- **Heat pump water heaters (HPWH)** that are solely dedicated to the production of DHW.

These technologies can be further sub-categorized into centralized or unitary (i.e., packaged and/or modular) configurations. This white paper examines the emergence of electric heat pumps as replacements and/or retrofits for fossil-fuel boilers and water heaters:

- Providing a technological overview
- Discussing the drivers and barriers for adoption
- Detailing advancements in enabling compression technologies

Behind the shift from gas to electric

In commercial buildings, decarbonization refers to activities, strategies, or technologies that reduce greenhouse gas emissions. These include reducing fossil-fuel use (i.e., oil, gas, or coal) or replacing fossil-fuel-generated electricity with renewable sources, such as solar or wind.

In the context of commercial HVAC and/ water heating systems, decarbonization occurs through a combination of electrification, improved energy efficiency and the transition to lower-GWP refrigerants — all of which can be achieved with to-water heat pumps.

Industry estimates that roughly 37 percent of energy use in U.S. commercial buildings can be attributed to space and water heating. Natural gas remains the predominant energy source for water heating.

- Approximately 34 percent of U.S. commercial buildings utilize natural gas as their primary energy source for space heating, with many employing gas-fired hydronic (hot water) systems.
- 18 percent of natural gas consumption in commercial buildings can be attributed to gas-fired boilers for DHW.

The multi-family apartment sector also shares HVAC equipment strategies with commercial buildings. Per recent government estimates, the distribution of water heating systems in U.S. multi-family apartment complexes varies by building size:

- Small apartment buildings (2–4 units): Approximately 52 percent have in-unit (unitary) water heaters; centralized systems serve 48 percent.
- Large apartment buildings (5 or more units): About 56 percent utilize centralized water heating systems; the remaining 44 percent have unitary water heaters.

Technological overview

As momentum grows for building decarbonization and higher performance standards, stakeholders are migrating from fossil fuels to electric water heating systems, including hydronic heat pumps and heat pump water heaters.

Hydronic heat pumps

Designed as electric alternatives to fossil-fuel-fired boilers, hydronic heat pumps can provide both cooling and heating for comfort and domestic hot water. The heating process extracts heat from the outdoor air (or water) and transfers it to a hydronic loop, where heat is distributed through radiators, fan coils, and radiant floors. The process is reversed for cooling, relying on chilled water loops or air-handling units to distribute cooling for comfort.

Hydronic heat pumps are ideal for retrofits for many reasons:

- ✓ Integrate well with existing hydronic distribution systems
- ✓ Well-suited for incremental, phased-in retrofits — i.e., one zone at a time
- ✓ Offer packaged unit (i.e., modular) installation flexibility
- ✓ Excellent performance in low-to-moderate temperature applications (120 °F water supply or lower). *Note: Modern inverter-driven scroll models with vapor injection can deliver 130 °F+ water at high efficiency.*)

Heat pump water heaters (HPWHs)

Designed to provide domestic hot water for sinks, showers, laundry and other purposes, HPWHs are a sustainable alternative to fossil-fuel-fired water heaters or central boilers. System configurations can be tailored to building requirements:

- Unitary/integrated systems: Self-contained systems in which all key components are combined into a single appliance.
- Split systems: The heat pump and the water tank are installed separately. The heat pump is located outdoors, and the water tank is located indoors.

HPWHs are often designed with thermal storage tanks, enabling systems to store hot water during off-peak times. Modern HPWHs are now up to 75 percent more efficient than gas-fired systems, with lower operating costs dependent on local energy and gas rates (*See sidebar: Estimating the energy savings and decarbonization potential*). Systems optimized with CO_2 have proven particularly effective in cold climates while complying with ultra-low-GWP mandates.

Retrofits may require upgrades to recirculation systems or storage tank sizing to match gas-system recovery rates. Consider dedicated heat pump plant rooms to minimize ambient noise and temperature impacts.

State and local mandates drive heat pump adoption.

Although adoption of electric water heating is still relatively new in the U.S., progressive states and cities such as New York, New York City, California and Washington are actively pursuing policies to phase out fossil fuels in commercial buildings while promoting the adoption of electric heat pump technologies.

New York

In May 2023, New York passed legislation prohibiting the use of fossil-fuel equipment in new buildings. The law takes effect in 2026 for buildings with seven stories or fewer and will be extended to all new buildings in 2029, with limited exemptions.

New York City

In 2021, New York City (NYC) enacted Local Law 154 (i.e., Building Electrification Law), which sets stringent emissions limits for new buildings, prohibiting the use of fossil fuels for heating, cooking and hot water systems. Enforcement began in 2024 on new buildings under seven stories and will expand into all other commercial and multi-family housing in 2027.

In 2025, NYC amended its Local law 97, making it one of the most aggressive plans for reducing building emissions in the nation, aiming for 40 percent reductions by 2030. Applying to existing buildings over 25,000 square feet, it sets GHG emissions caps based on building use, including the electrification of water heating systems.

Both NYC's building emissions laws reflect a growing emphasis on improving building energy performance standards (BEPS).

California

As of July 1, 2024, California building codes prohibit new buildings that burn fossil fuels on-site from receiving subsidies for electric line extensions. The move aims to disincentivize new gas infrastructure and encourage all-electric construction in new buildings.

Washington, D.C.

The Clean Energy DC Building Code Amendment Act of 2022 banned the use of gas in all new construction and commercial building remodels, including apartment complexes with more than three stories, which will take effect December 31, 2026. An industry coalition has introduced a legal challenge to this rule.

Washington

In 2022, the Washington State Building Code Council updated the building codes to require heat pumps for all space heating/cooling and water heating in new commercial and residential home construction.

Denver, Colorado

Denver has updated its building codes to ban gas furnaces and water heaters in new commercial and multifamily buildings, which took effect in 2024. Starting in 2025, owners of existing buildings were required to install electric systems when replacing gas equipment.

These states and cities are at the forefront of transitioning away from natural gas in buildings and promoting the adoption of heat pump technologies, aligning with broader climate goals and efforts to decarbonize the building sector.

Barriers to adoption and incentivization

Recent data from the Energy Information Administration indicates that less than one-third of U.S. commercial buildings are all-electric. Among these, only about 11 percent utilized heat pumps for space heating. This data suggests that the overall adoption of heat pumps in the commercial sector remains limited.

Many factors are contributing to the slow uptake of heat pumps, as retrofits for boilers in commercial buildings:

High upfront costs

Retrofitting existing buildings with heat pump systems can be expensive, with estimates ranging from $12 to $21 per square foot. These costs encompass equipment, installation, and necessary infrastructure upgrades.

Operational/technological challenges

Hydronic heat pumps typically operate at lower water temperatures compared to traditional gas boilers, while HPWHs generally meet the expected water leaving requirements.

In cold climates, it may be more challenging to produce hot water with the required leaving temperatures for the application. Recent advancements in variable-speed, vapor-injection compression technology are enabling the production of higher water temperatures to alleviate cold climate challenges.

Designers must size systems appropriately to achieve the desired capacities and often keep their gas-fired boiler ready in reserve to operate only when needed in a dual-fuel configuration. Existing hydronic distribution systems may require modifications, such as increasing pipe diameters or enhancing insulation, to maintain heating performance.

Disruption concerns

Retrofitting can be disruptive to building occupants, especially in fully occupied or historic buildings, where access to existing systems is limited and modifications can be invasive.

Available incentives

State and local incentives are available to support the adoption of hydronic heat pumps and HPWHs in commercial and multi-family buildings, particularly in those states that prioritize decarbonization. Many utilities across the U.S. offer rebates for the installation of energy-efficient equipment. Stakeholders need to be aware of these opportunities and evaluate them on a case-by-case basis.

Consult with HVAC contractors or energy experts familiar with these incentive programs to ensure that the equipment meets the required efficiency standards and that installations comply with program guidelines.

Estimating the energy savings and decarbonization potential

Decarbonizing and improving energy efficiency are the primary drivers of electrifying water heating. Heat pumps are now up to 75 percent more efficient than gas boilers, meaning they produce significantly more heat for every kilowatt of electricity used.

For building owners/operators, this potential for energy savings represents a significant long-term benefit that can help offset equipment costs. Although installation conditions, electricity rates, natural gas costs and factors impacting performance vary widely, hydronic heat pumps and HPWHs can reduce energy costs compared to traditional gas-fired and electric resistance water heating methods.

In many cases, energy savings alone can provide a relatively fast return on investment (ROI).

Evaluating the cost of natural gas versus electricity rates (often referred to as "spark spread") in a specific region is an integral part of the decision-making process. Spark spread equals the price of electricity divided by the cost of gas. Thus, operating cost reductions may depend on having a low spark spread. When the spark spread is lower than a system's coefficient of performance (COP), an HPWH is more likely to reduce a building's energy bills.

Of course, decarbonization through a heat pump strategy also depends on the makeup of renewable resources of the local grid. As heat pump adoption adds to electrical loads, grid modernization will become an equally important part of the overall decarbonization equation.

More wind and solar sources will be needed to replace high-emission sources like coal and oil, resulting in heat pumps drawing from cleaner, less greenhouse gas (GHG)- intensive sources.

Leading the charge with innovative, integrated heat pump technologies

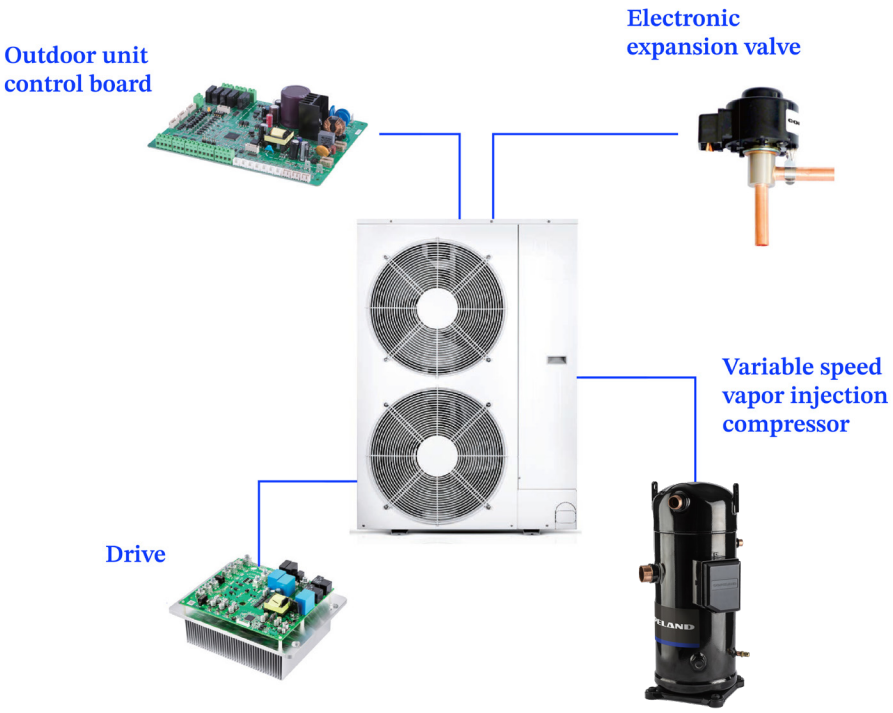
Copeland compression platforms, drives, controls, valves and components are engineered to electrify water heating and lead the evolution of hydronic heat pump and HPWH technologies. Supporting a broad range of capacities and application requirements, our solutions enable electric water heating systems to provide the water temperatures needed to achieve desired comfort levels while maximizing system efficiencies. We also support a variety of lower-GWP A1, A2L and CO_2 refrigerant options to align with stakeholder preferences and comply with refrigerant mandates.

Our water heating-optimized compression platforms utilize advanced fixed- and variable-speed compressor technologies with enhanced vapor injection (EVI) technologies to meet a variety of system, application and technological requirements:

- Featuring optimized operating envelopes for electric water heat applications
- Enabling systems to provide the heating capacity to achieve the needed water temperatures (120 °F to 200 °F)
- Supporting high cooling to heating ratios to ensure occupant comfort in peak summer and low winter temperatures
- Providing year-round energy efficiency and optimization in part-load conditions lowers indirect emissions

Copeland's breadth of fixed, modulated and variable-speed compression technologies, integrated controls and packaged system approach, maximizes system performance and design simplicity. The legendary reliability of our compression platforms offers OEMs and system designers the confidence to replace or retrofit gas-powered boiler systems with heat pumps.

Backed by Copeland's rigorous testing capabilities, research labs, partnerships and field trials, our water heating solutions are designed to meet and exceed expectations for performance, reliability and efficiency. We're leading the charge to help ensure maximum quality and value for the to-water heat pump equipment supply chain.



Harness the sustainability potential of to-water heat pumps

Hydronic heat pumps and heat pump water heaters (HPWHs) have tremendous potential to decarbonize traditional, gas-fired boiler systems for space heating and DWH.

Hydronic heat pumps offer dual heating and cooling capacity, providing both chilled and hot water to support space cooling, heating and domestic hot water. Available in centralized split, packaged or modular configurations, these all-electric units are ideal for multi-family complexes and commercial buildings.

HPWHs represent the ability to decarbonize traditional boiler systems in commercial buildings, offering high COP, significant energy savings and the potential to phase down the use of gas-fired systems.

Reliable, advanced compression, controls and system technologies will be necessary to achieve comparable heating to its gas-fired predecessors, including fixed- and variable-speed models with EVI technology.

Copeland is partnering with leading commercial OEMs and research partners to create the next generation of electric water heating solutions. We're demonstrating our commitment to decarbonization and innovation through continuous investments in research and development (R&D) and testing that ensures our products exceed the highest reliability, performance and efficiency standards.

Please visit our website to learn more about how we're leading the energy transition by supporting the evolution and acceleration of electric water heating technologies.

To learn more, visit **copeland.com**

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