



## White Paper: Building Efficiency via Electrification of Domestic Water Heating – The Final Frontier of Sustainability

Heat pumps are the only viable carbon-free solution for domestic water heating, and can help make NYC 80x50 goals a reality

The commercial and residential building sector consists of many structures that are inefficient with natural resources, resulting in serious environmental pollution. In fact, this sector is responsible for 40% of the energy and 70% of the electricity used annually in the U.S. , and 39% of the carbon dioxide (CO<sub>2</sub>) emitted each year in the nation.

Although steps are being taken to make buildings more efficient, such as better lighting, ventilation and air tempering, such efforts only cover about two-thirds of building-efficiency needs. Where these initiatives are falling short is in one primary area, domestic water heating, and making up this deficit can push building efficiency in New York City to new levels – the final frontier of building sustainability.

### Challenges of Conventional Domestic Water Heating

The efficiency gap mentioned above exists because the majority of hot water in New York City is currently produced via conventional gas-fired boilers, which get the job done and take advantage of inexpensive gas rates. These older boilers do not provide any strong efficiencies, but they work, gas is cheap and residents get their hot water.

The problem is that gas-fired boilers produce hot water at a major cost to the environment and energy efficiency. They waste energy, have a low Coefficient of Performance (COP) – meaning they expend a lot of resources to reach the end product – and emit large amounts of CO<sub>2</sub>. Therefore, they run in direct contrast to New York City's 80x50 sustainability and electrification plans, which aim to cut greenhouse gas (GHG) emissions by 80% by 2050. What's more, gas-fired boilers require major investments on the part of the utility to establish and maintain costly gas lines. The reality is that many new housing projects in New York City will have to be built in areas with undersized gas lines, and in some spots where gas-line installation is impossible, making domestic water heating with natural gas more costly, if even possible.

### Challenges Faced by Multifamily Buildings

Multifamily housing is the sector in New York City with one of the greatest needs for domestic hot water. The majority of these buildings run on older non-efficient gas-fired boilers. As a result, domestic water heating accounts for a whopping 22% of GHG emissions from multifamily buildings in New York City. The needs of multifamily housing are nothing to scoff at since the sector represents over 40% of the total building area and nearly 30% of total GHG emissions in New York City. And with apartment construction at a 30-year high in New York City, multifamily developments are sprouting up across the boroughs, including in some spots with few or no gas lines.

### Heat-Pump Water Heaters as the Solution

There's a better way to provide domestic hot water, and that's via heat-pump water heaters (HPWH). This technology offers commercial and industrial users of sanitary hot water an energy-efficient means of heating water to temperatures as high as 185°F in a single pass without using any gas. Electricity-powered heat-pump water heaters use the same operating principle as an air-conditioner or domestic refrigerator. The heat pump gathers heat from the surrounding air, and through the refrigeration cycle, deposits the heat into water at a useable temperature.

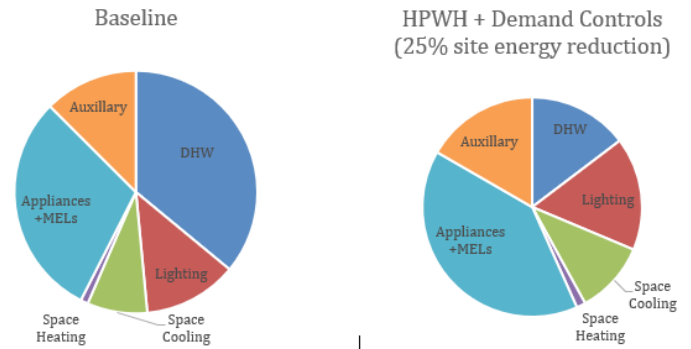
This principle of moving heat with a heat pump, rather than generating it by burning fossil fuels or electric resistance, makes water heating with heat pumps the best choice for conserving energy. Depending on the temperature of the source air or water, domestic water can be heated using one-third to one-fourth of the energy required by electric resistance or gas. In addition,

heat-pump water heaters are a strong complement to New York City's 80x50 plan for building sustainability and electrification. For example, Con Edison is looking into electrification of heating to reduce customer gas demand, and an optimal choice for this goal is heat-pump water heaters.

### Results of Implementing Heat-Pump Water Heaters

Implementing electricity-powered heat-pump water heaters in New York City's buildings will lead to many positive results. These include:

- Significant reduction in energy use for domestic water heating.
- The elimination of the need for gas and its accompanying infrastructure to produce domestic hot water.
- Substantial decreases in GHG emissions from buildings.
- Reduced energy and water bills.
- Key support for New York City's 80x50 building sustainability and electrification initiatives.
- Up to a 25% reduction in energy use for domestic hot water production, which is shown in the accompanying chart.



### Colmac is the Best Choice for Heat-Pump Water Heaters

When deciding on the right heat-pump water heater for the job, the optimal selection is Colmac, one of the world's leading manufacturers of water-heating heat pumps. Colmac pioneered this technology in the 1980s, and the company is constantly innovating to realize the best products possible.

- Gas-free operations: Colmac heat-pump water heaters are fully electric systems and can achieve a complete domestic hot-water load using the heat pump, without requiring any gas or electric resistance as backup.
- Improved sustainability: The Colmac high-efficiency vapor compression cycle method has zero direct CO<sub>2</sub> or carbon monoxide (CO) emissions, requiring no fossil fuels and granting LEED design points, and utility incentives.
- Tremendous efficiency: Colmac systems offer COPs of 3-6, which makes them 300-600% more efficient than a boiler and the most efficient method available today for heating water.
- Lowest energy costs: With heat-pump technology, three to six units of energy are moved from the source to the process water for every input of electrical power. Using ample thermal storage, much of the cost can be shifted to off-peak hours. Further, while heating potable water, the unit creates cool air or cold water, which reduces cooling costs simultaneously.
- Equal total costs: With no gas, the gas-piping and flue requirements of boilers are eliminated. This means considerably less construction, equipment and installation costs, thus making total costs equal to a conventional system and payback irrelevant.
- Valuable space regained: With zero gas piping and no flue needed, valuable real estate is opened up inside the building that can be used for other revenue-generating uses.
- Easy installation: The unit is modular and can fit through standard-sized doors and elevators in New York City, thus making installation quick and stress-free.
- Excelling in New York City weather: The unit is built to handle temperatures as low as -13°F, which is well within the climate extremes of New York City winters.
- Heat recovery and cooling: The unit recovers heat from building exhaust and produces cooling as a byproduct, thus bolstering efficiencies.
- Safe, sanitary water: By heating water to 140°-165°F in a single pass, the unit creates a true Hazard Analysis and Critical Control Points (HACCP) step in eradicating Legionella in hot water storage systems, without UV or chemicals. The unit is also certified as safe for potable (sanitary) water with double-wall, vented condensers that fully isolate refrigerant from potable water and prevent cross-contamination.
- Unparalleled reliability: The unit is designed for low maintenance and easy service, with an expected life span of over 15 years while using standard refrigerants that are readily available.

### In Summary

Domestic water heating via gas-fired boilers in New York City is inefficient, wasteful, costly and polluting. Such antiquated water-heating systems are holding back efficiency efforts and run counter to NYC 80x50 building sustainability and electrification goals. There has to be a better way.

Electricity-powered Colmac heat-pump water heaters are the solution since they don't use gas and can produce hot water using a quarter of the energy compared to conventional methods. By implementing these systems in New York City, carbon emissions will be substantially curbed and all buildings can take their efficiency performance to the next frontier of sustainability.