

# Sizing Multi-Family Electric Water Heating Swaps

## Introduction

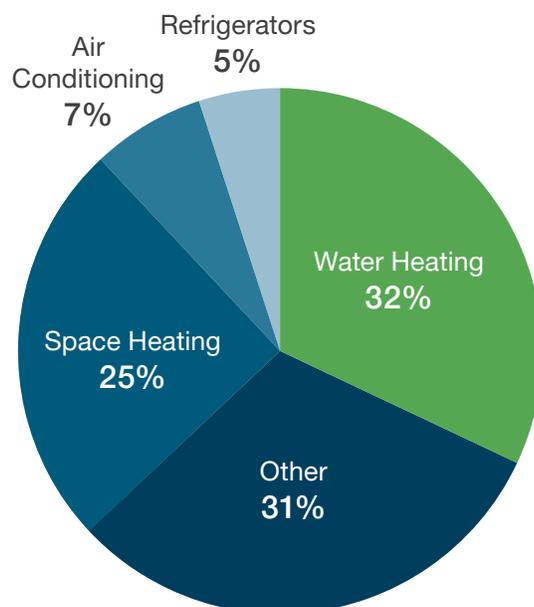
This fact sheet is intended to assist those looking to make the transition to all-electric water heating systems from systems that rely on fossil fuel combustion. Electrifying building water heating systems allows building owners to futureproof and decarbonize their property while improving indoor air quality and streamlining utility bills.

Domestic hot water (DHW) represents, on average, 32% of the site energy use for multi-family buildings.

Multi-family buildings generally provide DHW to occupants in one of two ways: via a centralized boiler with recirculation or unitized (individual hot water heaters in dwelling units). This guide focuses on replacements for buildings with centralized systems.

## Average Site Energy End Use for Multi-Family (5+ units) Buildings

Source: U.S. Energy Information Administration, 2015 Residential Energy Consumption Survey





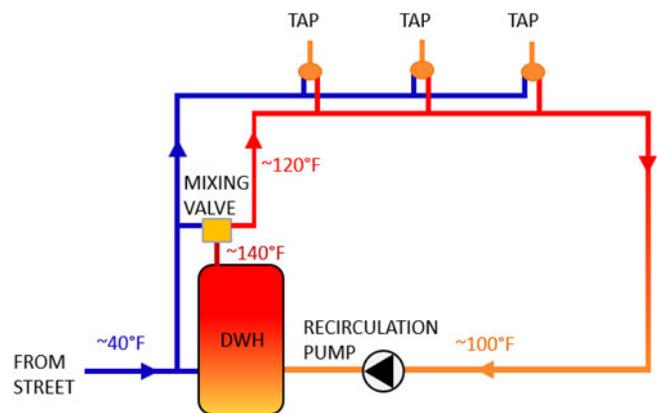
## Multi-Family Centralized Systems

Generally, centralized DHW systems operate by piping water from the municipal water system into a building and heating it to at least 140°F to prevent Legionella and other water-borne diseases. That water is then mixed with cold water to bring the temperature to around 120°F, where it circulates throughout the building and is delivered to taps in dwelling units.

In order to ensure hot water is available on demand, most buildings will implement recirculation loops that keep water constantly flowing and mixing with new water brought in from the street.

This system has the advantage of providing hot water quickly to dwelling units but has the disadvantage of being very energy-intensive and reliant on combustion of fossil fuels to heat the water in the boiler system.

Fortunately, technologies such as Heat Pump Water Heaters (HPWH) are emerging to allow buildings to electrify DHW. HPWHs use electricity and refrigerant to take heat from the ambient air and transfer it to water via a heat exchanger. This water can then be circulated and delivered to units with the same piping already utilized by the central DHW system.



Central plant with DHW reheat loop. Source: Steven Winter Associates

# Appropriate Steps to Take When Planning Your Water Heating Swap

## 1

### Understand Your True Demand

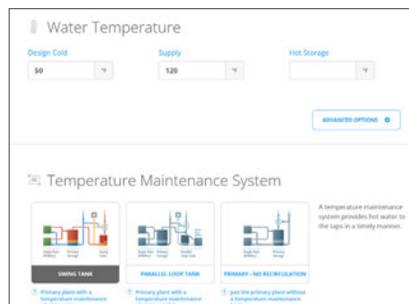
Prior to selecting and installing a HPWH as a replacement for a standard boiler system, you should first evaluate the actual demand for DHW in your building. Oftentimes central DHW systems are oversized to ensure hot water is available at each unit almost instantly. This generally is not an issue for gas boilers because they are capable of modulating output via smart controls and take up a relatively small footprint.<sup>1</sup>

HPWH have larger footprints, require right-sizing of loads, and shouldn't cycle more than 6 times per hour if they are to maintain efficiency. Ideally, the heat pump is running regularly to heat water most efficiently. This means that excess storage capacity is more important with HPWH systems than excess heating capacity. Therefore, it is important to understand the true demand for your building. If your DHW system is submetered and you can calculate the average and peak demand for your system, start there. If not, investigate your true demand by auditing unit fixture capacities.

## 2

### Calculate Loads Accurately

It is imperative that you not size a HPWH system using a boiler sizing methodology. As mentioned earlier, boilers can be oversized without dramatically impacting the performance (and cost) of supplying DHW. To properly size your system, utilize the [Ecotope Ecosizer](https://ecosizer.ecotope.com/) tool to better understand your loads and potential system size.<sup>2</sup> Using the Ecotope Ecosizer tool allows you to vary inputs to better understand the HPWH size and storage capacities required for your space. Oversizing electric hot water systems can have a higher cost impact than gas systems, as electric utility costs are generally greater than those of gas. Additionally, oversizing reduces the efficiency of heat pump systems.



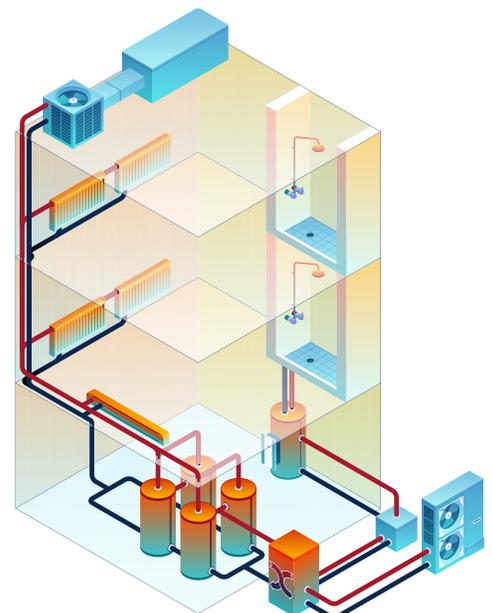
Screenshot of Ecosizer tool.

## 3

### Properly Install

Heat pumps are more efficient at generating heat than burning fossil fuels but require space to operate. This is because they extract heat from ambient air using the refrigeration cycle and then reject cooler air into their surroundings.

Some spaces may not be suitable for a HPWH due to the amount of space available vs the amount of space a HPWH takes up. Some systems will require multiple heat pumps to meet capacity and may require indoor and outdoor units to properly exchange heat. If a system is installed improperly or is not provided with the amount of space required to operate, it will lose efficiency quickly and operational costs will quickly escalate.



1 Oram, Shawn. Heat Pumps Are Not Boilers, [www.aceee.org/sites/default/files/pdf/conferences/hwf/2018/1c-oram.pdf](http://www.aceee.org/sites/default/files/pdf/conferences/hwf/2018/1c-oram.pdf)

2 Ecotope Ecosizer, <https://ecosizer.ecotope.com/sizer/>

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