

Seattle Permits

— part of a multi-departmental City of Seattle series on getting a permit

Heat Pump Water Heating for Commercial and Multifamily Buildings

November 10, 2021

Commercial heat pumps can produce domestic hot water using about a third of the energy of conventional gas and electric boilers. Heat pump water heaters (HPWHs) using CO₂ refrigerant can even deliver hot water well below freezing temperatures. Heat pumps extract heat from the air (even cold air) and transfer that heat into the incoming cold water. Seattle requires heat pump water heating for most new buildings and new “central water heating” equipment in existing hotel and multifamily buildings. Central water heating refers to water heating systems that serve multiple dwelling or sleeping units, a circulating hot water system, or a hot water system that serves numerous building areas.

Where Required

You must provide heat pump water heating (HPWH) for the following building categories if you apply for a permit after January 1, 2022. (See Section C404.2.3 of the Seattle Energy Code for the complete scope.) A general summary of those categories includes:

- **Multifamily buildings four stories or taller with central water heating systems:** new construction, substantial alterations, and equipment replacement.
- **Hotels/motels:** new construction, substantial alterations, and equipment replacement.
- **Other commercial buildings:** As of October 2021, the Seattle City Council is considering an amendment that would extend the HPWH requirements to include most commercial buildings, with exceptions for smaller systems. If such an amendment is approved, an effective date would be set for some time in spring of 2022.

This Tip concerns “commercial buildings.” Single-family houses, two-family houses, townhouses, and 1-3 story multifamily buildings are considered “residential buildings” and do not have to comply with these HPWH code requirements.

Permits Required

Obtain all applicable permits for your HPWH system in the City of Seattle, including:

- Plumbing permit from Public Health Seattle King County (PHSKC), which covers:
 - Piping connecting the HPWH equipment, storage tanks, and the distribution system
 - Piping insulation
 - Circulating pumps, valves, strainers, mixing valves, and other components of the hot water distribution system
 - Condensate drainage
- Mechanical permit (can be part of construction permit), which covers:
 - The heat pump equipment itself, including sizing calculations
 - Fans and ductwork for indoor air-source heat pumps
 - Noise regulations
 - Structural support for tanks and equipment (unless slab on grade)
 - Land use regulations on equipment height and location
- Boiler permit, which covers:
 - Hot water storage tanks larger than 37.5 gallons (11.25 gallons in A, E, or I occupancies)
 - Tank insulation
 - Seismic bracing
 - Note that each storage tank requires a separate boiler permit

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- Electrical permit, which covers:
 - Wiring connections
 - Circuiting and overcurrent protection devices
- Refrigeration permit, which covers:
 - Systems with field-installed refrigerant piping connections, typically seen in mini-split or split system heat pumps or where an enclosed room contains substantial refrigerant quantities. See Section 119 in the Seattle Mechanical Code.

Apply for the plumbing permit at [Environmental Health's online services portal - King County Public Health Seattle King County \(PHSKC\)](#).

Apply for all the other permits at [How Do You Get a Permit? - SDCI | seattle.gov](#).

Heat Pump Capacity Sizing

Heat pumps are less efficient in colder temperatures; so, some systems may require supplementary electric resistance heating for very cold days. Size your HPWH system capacity to be large enough to provide all the required water heating using the heat pump's compressor when the surrounding air is 40°F **and** large enough for at least half of the required water heating with the compressor when the surrounding air is 24°F. In each case, the HPWH capacity must also accommodate defrost cycles, as recommended by the manufacturer. Note that the ambient air temperature in below-grade garages might never fall below 45°F. Some HPWH types, particularly those using CO₂ refrigerant, maintain substantial efficiency in temperatures well below freezing and do not require supplementary heat.

Use a system sizing tool approved by SDCI or a sizing recommendation provided by the manufacturer of the HPWH equipment you are using. One free online tool for sizing multifamily central water heating systems is called Ecosizer, available at <https://ecosizer.ecotope.com/sizer/>. This tool allows you to experiment by varying the relative sizes of the heat pump capacity and the hot water storage tank capacity. HPWH systems heat water more slowly than conventional gas water heaters, so you will likely need a larger storage volume. Another tool is available from Nyle upon request through Columbia Hydronics Company – <https://www.chhydro.com>.

HPWH System Design Air Temperature Limitations

Central HPWH systems have varying minimum air temperature limitations that largely depend on the refrigerant they use.

Locate HPWHs with warmer minimum air temperature requirements (like those utilizing R-134a refrigerant) in a below-grade parking garage or a similar space. These spaces should have substantial air movement and air temperatures that never get lower than about 45°F. Garage locations are also ideal because the required garage exhaust airflow can serve as the heat pump's air source. In addition, you might be able to locate some of the HPWH equipment in a garage corner to use otherwise empty space.

You can locate HPWHs with cooler minimum temperature requirements (like those utilizing CO₂ refrigerant) outdoors on a roof or in a garden because HPWHs that use CO₂ refrigerant maintain high efficiency even at temperatures below 10°F. Also, multiple manufacturers are gradually releasing equipment using newer refrigerants that meet Washington state GWP (global warming potential) limitations.

Pipe Insulation

Typical pipe insulation thickness is shown in Table C403.10.3, excerpted below.

Water Supply Temperature	Pipe Size	Required Insulation Thickness <i>See C404.6 and C403.7.3.1</i>	
		Typical	Circulating Loop <i>(add 1")</i>
105 - 140 °F	Less than 1-1/2"	1"	2"
105 - 140 °F	1-1/2" or greater	1-1/2"	2-1/2"
141 - 200 °F	Less than 1-1/2"	1-1/2"	2-1/2"
141 - 200 °F	1-1/2" or greater	2"	3"

- Seattle code requires an extra inch of insulation thickness for the circulating loop.
- Typical (not circulating loop) piping can be installed in framing space that has at least R-3 (1") insulation all around it.
- The final run from a circulating loop to the fixture does not require insulation.

Hot Water Storage Tank Insulation

Hot water storage tanks are typically factory-insulated with R-12.5 insulation. However, if the water storage temperature is designed to be higher than 130°F, Seattle code (Section C404.6.1) requires them to be wrapped with additional insulation, R-2 for every 10°F above 130°F.

Example: Water stored at 160°F would require the tank to be wrapped with an additional layer of at least R-6 (R-2 x 3 x 10°F) insulation.

Hot Water Storage Volume

Provide sufficient hot water storage to satisfy the anticipated peak demand periods. For hotel and multifamily buildings, this is usually a 4-hour period in the morning. The code does not specify the exact storage quantity, just that it be determined using an “approved” methodology. This methodology could be the Ecosizer or Nyle online tools mentioned above.

Supplemental Water Heating

Supplemental electric resistance (but not fossil fuel) water heating is permitted under several conditions. Do not provide supplementary water heating capacity that is greater than the heat pump water heating capacity at an entering air temperature of 40°F. The allowable conditions include:

- Temperature maintenance for reheating the water in the circulating loop
- Compressor coil defrost
- Heat trace of piping
- Supplemental heating when incoming air temperature is below 40°F, provided that the heat pump compressor continues to operate down to 24°F
- Supplemental heat downstream from a multi-pass HPWH system
- Stand-alone water heaters serving single zones and not served by the circulating loop

Commissioning

Water heating systems larger than 200,000 BTU/h system capacity require commissioning. System capacity is defined as the capacity of the primary heat pumps only, at 40°F outside air temperature.

Metering

Water heating systems with electrical demand larger than 50 kVA require end-use submetering. The 50 kVA threshold includes the total power to the heat pumps

plus the supplementary heating at the outdoor air design temperature of 24°F.

Required Information on Permit Documents

For all permits, provide the following:

- Scale plan drawing showing all HPWH system components with dimensions

For plumbing permit:

- Piping connections, with sizes of all pipes in the system
- Insulation thickness and R-value for each pipe size
- Details of system components

For further information on plumbing permit requirements, see [Plumbing and gas piping - King County](#).

For mechanical permit:

- Using an approved methodology, provide calculations demonstrating that the system can provide all required hot water to the building when the outdoor air temperature is 40°F and provide at least half of all required hot water when the temperature is 24°F
- Noise generated by equipment

For boiler permit:

- Size and number of hot water storage tanks
- Hot water storage temperature
- Tank insulation R-value
- Seismic restraint details

For building permit:

- Location and fully loaded weight of each heat pump, each storage tank, and any other equipment weighing over 400 pounds
- Structural support calculations and details
- Elevations of roof-mounted equipment, with dimensions to highest point

For electrical permit:

- Project's available voltages, to compare with equipment requirements
- Nameplate data for all electrical equipment

For Seattle SDCI permit application instructions, see [Tip 100 - Getting a Multifamily or Commercial Construction Permit from SDCI](#).

For permit fees, see the [SDCI - 2021 Fee Subtitle](#).

NEEA Advanced Water Heating Specification (AWHS) for Central Systems

The Northwest Energy Efficiency Alliance (NEEA) has developed a general integrated specification for central HPWH systems in multifamily, hotel, and commercial buildings. It addresses energy performance, occupant comfort, demand response, and details proper installation, startup, and operation. Along with the HPWHs themselves and hot water storage tanks, the AWHS includes the circulating hot water system, mixing valves, controls, and piping, among other elements.

A qualified products list (QPL) will be developed as manufacturers submit complete systems that include warranty, startup routine, alarms, and data connectivity. In addition, each manufacturer will provide guidance for equipment and storage tank capacity and a complete sequence of operation definition.

Although four tiers are defined, compliance with any Tier is deemed to be sufficient.

Look for Version 8 of the NEEA Advanced Water Heating Specification (AWHS) at [Northwest Energy Efficiency Alliance \(NEEA\) | Advanced Water Heating Specification](#) anticipated publication in late 2021.

During and After Installation/Construction

- SDCI strongly recommends that you request a pre-construction meeting to ensure that each of the construction trades and SDCI inspectors agrees on the final layout and details.
- Do not cover any system connections or components until inspections are complete.
- Perform water heating system commissioning per Seattle Energy Code Section C408.3.
- Provide commissioning report or completed commissioning checklist to the inspector before final inspection.
- Boiler inspectors must inspect hot water storage tanks larger than 120 gallons upon installation and every two years after that.
- Request plumbing inspection after mechanical, electrical, and boiler inspections are complete and any required changes are completed.

Where to Find HPWH Requirements:

The [2018 Seattle Energy Code](#) is available for online viewing. Heat pump water heating requirements can be found in three different portions of the energy code:

- **Section C404.2.3** for basic HPWH requirements, applicable to all buildings for permits applied for after January 1, 2022.
- **Section C406** requires buildings to also achieve several “additional efficiency credits,” among which are two credit options for HPWHs.
 - The Section C406.8 efficiency package for basic HPWH systems will expire on January 1, 2022, as it will then become a basic requirement in the Seattle code.
 - The Section C406.9 efficiency package, which requires HPWH with low global warming potential (GWP) refrigerant and doesn’t permit any supplementary (non-heat pump) heating, will remain available for several credits.
- **Section C408.1** requires commissioning (but check exception 2) and Section C408.3 specifies the requirements for commissioning water heating systems.
- **Section C409.3.2** requires sub-metering for water heating systems requiring at least 50 kVA power.
- **Section C503.5** for alterations to existing water heating systems.

For Further Information

- [NEEA Advanced Water Heating Specification v. 8.0](#) (nea.org)
- Heat pump presentation by Ecotope at ACEEE conference “Heat Pumps Are Not Boilers” [Best Practices in Central Heat Pump Water Heating](#) (aceee.org)
- Heat Pump Water Heating presentation by Seattle SDCI and Rushing Engineers, presented by SCL Lighting Design Lab. See June 22, 2021: [Course Recordings and Handouts | Lighting Design Lab](#)

Access to Information

Links to electronic versions of SDCI **Tips**, **Director's Rules**, and the **Seattle Municipal Code** are available on the “Tools and Resources” page of our website at www.seattle.gov/scdi. Paper copies of these documents, as well as additional regulations mentioned in this Tip, are available from our Public Resource Center, located on the 20th floor of Seattle Municipal Tower at 700 Fifth Ave. in downtown Seattle, (206) 684-8467.