Seattle Department of Construction and Inspections
sdci
Tip 424
Seattle Permits
— part of a multi-departmental City of Seattle series on getting a permit

Plumbing and Heat Pump Water Heating for Commercial and Multifamily Buildings

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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 CO_2 refrigerant can even deliver hot water when the outdoor temperatures are well below freezing. 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

The "Fossil Fuel Compliance Path" (FFCP) permits gas or electric resistance water heating equipment to be installed, provided that the building earns sufficient additional efficiency credits from Section C406 to compensate for the reduced efficiency in comparison with heat pump water heaters. The FFCP is discussed in more detail below.

If not using the FFCP, you must provide electric air-source heat pump water heating (HPWH) for most buildings (See Section C404.2.1 of the Seattle Energy Code for exceptions). A ground-source heat pump water heating (GSHP) system is also acceptable. Of the ten exceptions, a few of the most commonly used include:

- **Small systems:** You can use electric resistance water heating if the total water heating capacity in your building or project is no greater than 24 kW plus 0.1 watts per square foot.
  - A 10,000sf building would be permitted 24,000 + (0.1 x 10,000) = 25,000 watts = 25 kW of electric resistance water heating.
  - A 100,000sf building would be permitted 24,000 + (0.1 x 100,000) = 34,000 watts = 34 kW of electric resistance water heating.

For buildings with multiple tenants, this limit can be prorated based on the area occupied by each tenant.

- **Instantaneous water heaters**. You can install local point of use instantaneous electric water heaters serving nearby fixtures. These don't have to be included in the 0.1W/sf limit for the small systems exception.
- **Unitary heat pump water heaters**. You can install unitary (all-in-one) electric heat pump water heaters in conditioned spaces, if they're sized to operate without supplementary electric resistance heat, and if the space is heated by heat pump or waste heat.

This Tip only concerns "commercial buildings." Single-family houses, two-family houses, and townhouses are considered "residential buildings" and have separate requirements in the "residential buildings" portion of the energy code.

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
- **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 to provide 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 CO_2 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**. 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**.

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 with 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 lower minimum temperature requirements (like those utilizing CO_2 refrigerant) outdoors on a roof or in a garden because HPWHs that use CO_2 refrigerant maintain high efficiency even at temperatures below 10°F.

Pipe Insulation

Typical pipe insulation thickness is shown in Table c404.6, copied below.

Table C404.6
Required Pipe Insulation Thickness for Service Water Heating

		Nominal Pipe or Tube Size					Insulation Conductivity	
Location	Water Temperature, °F	≤ 1”	1 to < 11/2"	11/2 to < 4	4 to < 8	8 or larger	Conductivity Btu • in. / (h • ft2 • °F)[b]	Mean Rating Temperature, °F
Circulation Loop Piping not in-partition	105-140	2.0	2.0	2.5	2.5	2.5	0.21 - 0.28	100
	141-200	2.5	2.5	3.0	3.0	3.0	0.25 - 0.29	125
All other piping not in-partition	105-140	1.0	1.0	1.5	1.5	1.5	0.21 - 0.28	100
	141-200	1.5	1.5	2.0	2.0	2.0	0.25 - 0.29	125
In-partition[a] Circulation Loop Piping < 1-1/2 inch	105-140	1.0	1.0	N/A	N/A	N/A	0.21 - 0.28	100
	141-200	1.5	1.5	N/A	N/A	N/A	0.25 - 0.29	125
In-partition[a] All other piping < 1-1/2 inch	105-140	1.0	1.0	N/A	N/A	N/A	0.21 - 0.28	100
	141-200	1.5	1.5	N/A	N/A	N/A	0.25 - 0.29	125

[a.] In a partition within a conditioned space, for piping smaller than 1-1/2 inch

[b.] For insulation outside the stated conductivity range, and for water temperatures outside of the stated range, conform to requirements of Table C403.10.3

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, an extra 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) insulation.

Hot Water Storage Volume

Provide sufficient hot water storage to satisfy the calculated 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, or any other approved method.

Supplemental Water Heating

Supplemental electric resistance 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

Plumbing Code Appendix M for Group R-2

Appendix M in the Seattle Plumbing Code, also known as the Water Demand Calculator, provides a method for sizing hot water demand load in Group R-2 (multifamily) buildings that have low-flow fixtures. Since low-flow fixtures are now mandatory in Washington state, use of Appendix M has been made mandatory in Seattle, except that pipe sizes are permitted to be one size larger than calculated using Appendix M. This saves considerable construction cost, as well as energy.

Note that 10 energy efficiency credits in Section C406 are available for projects that use the Appendix M pipe sizes, rather than one size larger. See Section C406.2.8. Recent studies have shown that even the use of Appendix M results in oversizing of hot water piping in multifamily buildings.

Additional Efficiency Credits

- **Section C406** requires buildings to achieve several above-code "energy efficiency credits" and "load management credits." Several of the available options pertain to service hot water systems, including:
  - **Section C406.2.6.1**. 30 credits for shower drain heat recovery.
  - **Section C406.2.6.2**. 111 credits for service water heat recovery.
  - **Section C406.2.8**. 10 credits for "right-sizing" distribution piping – using Appendix M minimum sized pipes rather than one size larger.
  - **Section C406.2.9**. 13 credits for high-performance temperature maintenance systems.
  - **Section C406.2.11**. 3 credits for low-flow showerheads (even lower flow than required by Washington state)
  - **Section C406.3.6** (load management credit). 248 credits (not a typo) for increased heat storage capacity with automatic controls that preheat water before peak electricity demand periods and suspend water heating during those periods.

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 applicable information listed in Section C103.2.1, including the following:

- Scale plan drawing showing all HPWH system components with dimensions
- Code edition and date of permit application
- Code compliance pathway from Section C401.2
- List of all selected additional energy credits and load management credits from Section C406

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
- List of any selected additional energy credits or load management credits from Section C406 related to plumbing or service water heating.

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 - 2025 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) has been developed as manufacturers have submitted complete systems that include warranty, startup routine, alarms, and data connectivity. In addition, each listed manufacturer provides 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.

Version 8 of the NEEA Advanced Water Heating Specification (AWHS) can be found at **Northwest Energy Efficiency Alliance (NEEA) | Advanced Water Heating Specification**.

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 **2021 Seattle Energy Code** is available for online viewing. Heat pump water heating requirements can be found in several different portions of the energy code:

- **Section C404.2** for basic HPWH requirements.
- **Section C404.3.3** requires use of the plumbing code Appendix M for determining demand load.
- **Section C404.6** and Table C404.6 set out requirements for pipe insulation.
- **Section C406** has requirements for "energy efficiency credits," among which are several credit options for service hot water systems.
  - Table C406.1 shows the required number of energy efficiency credits for new buildings and for additions, plus the required load management credits for new buildings.
  - Table C406.2 shows how many energy efficiency credits are available for each of 31 measures.
  - Table C406.3 shows how many load management credits are available for each of 7 measures.
- **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 with 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** (neea.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 Ecotrope, presented by SCL Lighting Design Lab. See May 30, 2023: **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 our website at **www.seattle.gov/scdi.**