



ENERGY STAR Central Heat Pump Water Heater Systems Discussion Guide July 2024

Overview and Context

The U.S. Environmental Protection Agency (EPA) and Department of Energy (DOE) are sharing this ENERGY STAR Commercial Heat Pump Water Heaters Discussion Guide and accompanying [Draft 1 Test Method for Central Heat Pump Water Heater Systems](#) to invite public input as we evolve the ENERGY STAR program for commercial water heaters to certify a wider variety of commercial heat pump water heaters (CHPWH), including so-called “central” systems that serve larger commercial buildings. This is the first step in a full specification revision which will also involve a review and, if indicated, revision of criteria for water heaters currently within scope. However, this discussion guide focuses on central HPWHs because we are seeking greater input on these products.

The EPA and DOE will host a webinar on **Thursday, August 15, 2024, from 3-5pm Eastern Time** to engage with the public on the content included in this discussion guide. The public is invited to submit written comments to HVAC@energystar.gov by no later than September 13, 2024. As always, public engagement is a vital ingredient in the success of the ENERGY STAR program and the EPA and DOE look forward to working with all parties to revise the ENERGY STAR specification for commercial water heaters.

The ENERGY STAR Version 2.0 Commercial Water Heaters Specification was released on December 29, 2017, and went into effect on October 1, 2018. It references the Federal test method for commercial water heaters and includes gas-fired instantaneous and tank-style water heaters, and electric heat pump water heaters over 12 kW power draw. For CHPWH, the result is that the specification includes only those with back up resistance elements, most of which are integrated units sold with the heat pump as a heat source and the tank together. This is typically an integrated unit but may also be a split system. These units are a good choice for many commercial applications with small loads. However, many large commercial buildings where people live (multifamily buildings, dorms, hotels, etc.) use central water heating plants where the hot water for the entire building is produced. Water is then typically circulated continuously in a loop to reduce the wait for hot water at individual fixtures. A CHPWH solution for this system design requires considerably more hot water production and storage than integrated CHPWHs deliver. The most likely solution would involve a system that includes one or more heat pumps filling one or more tanks, along with auxiliary tanks, controls, and pumps. The system would be designed for the needs of the building and typically assembled on site, similar to commercial boiler plants.

Virtually all ENERGY STAR commercial water heater shipments are gas units. From 2020-2022, AHRI shipments¹ of commercial water heaters remained consistently split at roughly 40% gas and 60% electric – electric in this case being electric resistance. And according to the 2018 Commercial Buildings Energy Consumption Survey (CBECS)², approximately 4.6 million commercial buildings use electric water heaters. While some of these are small point-of-use instantaneous units, electric resistance storage water heaters present a significant opportunity for immediate savings with switching to CHPWH. Annually, a typically sized ENERGY STAR CHPWH would save about 10 MWh compared with electric resistance, with an emissions savings equivalent to removing 1.5 cars from the road per year³.

- The EPA is seeking to better understand the market and role of small point-of-use instantaneous units relative to commercial electric water heater sales, the possibilities for CHPWH replacement of tank style

¹ [AHRI Monthly Shipments](#)

² [Energy Information Administration \(EIA\) - 2018 Commercial Buildings Energy Consumption Survey \(CBECS\) Data](#)

³ [Commercial Water Heaters | ENERGY STAR](#)

units, and how the fuel mix differs between larger central water heater systems and smaller single-unit systems. The EPA welcomes comment on these topics.

Scope, Definitions, and Test Method

The current Federal test method and ENERGY STAR specification do not explicitly exclude the heat pump unit central systems but also does not adequately address them. Some are excluded by the 12-kW input rate requirement, and all are listed and tested outside the context of a system and in a single operating condition of outdoor air temperature and inlet and outlet water temperatures. The EPA seeks to address these shortcomings.

Regarding the 12-kW input power limit, the DOE updated the definition of CHPWH to include heat pump units that do not include an electric resistance element, and the EPA will follow suit in order to prevent excluding units. Per the DOE⁴:

A commercial heat pump water heater (CHPWH) is defined as a water heater (including all ancillary equipment such as fans, blowers, pumps, storage tanks, piping, and controls, as applicable) that uses a refrigeration cycle, such as vapor compression, to transfer heat from a low-temperature source to a higher-temperature sink for the purpose of heating potable water, and operates with a current rating greater than 24 amperes or a voltage greater than 250 volts. Such equipment includes, but is not limited to, air-source heat pump water heaters, water-source heat pump water heaters, and direct geo-exchange heat pump water heaters.

The updated definition clarifies that all ancillary equipment (tanks, pumps, etc.) are part of the CHPWH, and provides the opportunity for the ENERGY STAR specification to address the impact of system design on performance. Ideally, there would be a test method that rates system performance as a whole. As a first step to developing such a method, the EPA and DOE have released with this discussion guide a draft ENERGY STAR Central Heat Pump Water Heater test method that tests each key component at a variety of conditions as appropriate. We propose this apply to central systems only and that integrated systems continue to use the Federal test method only. The EPA and DOE welcome feedback on the draft test method, in particular on issues discussed in note boxes throughout the draft.

Lastly, the updated definition makes no distinction between an integrated, residential-style HPWH and the heat pump unit used as part of a field-built system including tanks, pumps, and other equipment which may be from other manufacturers. The draft test method defines integrated and central heat pump water heaters and clarified how each should be tested. The EPA invites comment on the definitional distinction proposed in the test method draft.

While the current ENERGY STAR specification doesn't exclude water-source and direct geo-exchange HPWH, it was developed with only air source CHPWHs in mind, and the specification criteria may not be appropriate for other types. Other than changing the definition of CHPWH and the referenced test method, EPA has not considered changing the scope of the specification. The EPA welcomes comments regarding any CHPWHs excluded by the scope of the specification.

Specification Requirements

The key opportunity in this revision is to address central HPWHs as systems. That is also the key challenge because it means a product "model" must include reference to all of the components of the system, potentially leading to an unmanageable variety of combinations. The EPA envisions that the list of certified products would focus on the heat pump units themselves, but also include other accompanying equipment (tanks, pumps, controls, etc.) necessary for product certification and performance. It may be possible to structure the specification

⁴ [10 CFR § 431.102](#)

similarly to the residential water heater specification, where the label is applied to a group of system designs (as captured in installation instructions, parts lists, and system diagrams) rather than to a single component.

The EPA is considering the following and welcomes comment:

- What components must be addressed for adequate performance in the intended application;
- Whether the test method covers all of the components that are critical to the performance of the system and that require understanding to accurately predict the system performance;
- What variations of system configurations a single product certification should include. This issue relates closely to the system configurations that are covered by a single test method result, i.e., those that can be accurately predicted using the results of that test. Note that products could potentially be certified in more than one set of system configurations.

The EPA invites comment regarding central system design requirements that might be included in the specification. For example, requirements could include that the system can be configured to directly control backup or auxiliary water heaters, single-pass vs. multi-pass configuration, variable speed pumps, and controls.

Regarding single-pass vs multi-pass configurations, test method distinguishes configuration types based on their ability to meet a 140F leaving water temperature (LWT). Units that are able to provide 140F LWT from an entering water temperature (EWT), of 70F are single-pass units, otherwise they are designated as multi-pass. All units must test with an EWT of 125F, while single-pass units must additionally test with an EWT of 70F. Configuration doesn't significantly affect efficiency for gas and electric resistance systems, but it appears that heat pumps are more efficient in single pass. Many buildings have multi-pass WH systems which are well suited to large buildings with recirculation loops. Such systems can also include a larger burner for when hot water demand is high. The equivalent single-pass central HPWH system can also include a swing tank, not a heat pump, specifically for reheating the recirculation loop.

The EPA is considering the following and welcomes comment:

- Whether the use of single pass versus multi-pass configurations is based on application or efficiency, and whether configuration type would be a reasonable requirement for system certification;
- The extent to which certain design differences in heat pump units support single-pass configurations;
- The effect of high efficiency pumps on energy consumption and their relative cost;
- Adoption of a reliable pump efficiency metric and the appropriate level;
- Limitations of requiring high efficiency pumps in ENERGY STAR certified systems;
- Tank characteristics that affect system performance and should be addressed in the model definition and other effective methods of defining models;
- Whether and how to include flexible demand requirements such as excess energy storage capacity or ability to use specific DR protocols;
- Other system design savings opportunities;
- Method and manner of product performance reporting, including those that might benefit purchasers and incentive programs.

Next Steps

The EPA and DOE will host a webinar on **Thursday, August 15, 2024, from 3-5pm Eastern Time** to engage with the public on the content of this discussion guide. Public comments should be submitted by September 13, 2024, to HVAC@energystar.gov.

The EPA intends to release a draft of the new specification with the final draft test method, with the understanding that the Method is likely to require intervening drafts. As always, public engagement is a vital ingredient in the success of the ENERGY STAR program and the EPA and DOE look forward to working with all parties to revise the ENERGY STAR specification for commercial water heaters.