ENERGY STAR Boilers sunset proposal and development of new Air-to-Water Heat Pumps specification

Written comments on behalf of: Efficiency Vermont

Sunset Question: Should ENERGY STAR sunset the boilers v.3.0 specification?

Yes, this specification should sunset. The ENERGY STAR label has long been associated with high efficiency and best-in-class performance. Continued endorsement of "high efficiency" boilers undermines the value of the label. With an increasing shift to focus on decarbonization, maintaining the label for fossil fuel equipment is effectively an endorsement for investment in fossil fuel infrastructure, a direct contradiction to the goals of the organization[1]. Additionally, boiler field performance is tied to overall system integration, which commonly undermines claims of high efficiency from lab-based testing. Condensing boilers will not condense without low temperature distribution systems, resulting in poor performance despite high AFUE scores. Now is the time for ENERGY STAR to take a stance and restrict the label for equipment that creates a meaningful shift in market behavior by sunsetting all specifications for fossil fuel heating equipment.

Question 1: Is the name "ENERGY STAR Heat Pump Boilers" for the new specification preferable to "ENERGY STAR Air-to-Water Heat Pumps"? Is there another name that would better align with customer expectations of the product?

The preferred nomenclature for the new specification is "Air to Water Heat Pumps". Though not front of mind for the public at large, the industry in the US and around the world has long galvanized around this terminology. Although use of the term "boiler" has value for its general familiarity and internet search results, it carries too much baggage both in the limitations of the term (i.e., it does not account for the cooling capability of ATWHP) and through setting unrealistic expectations of the equipment (i.e., the ability to deliver water temperatures in line with today's fossil fuel boilers). Air to Water Heat Pumps is both descriptive and well established.

Question 2: Are there broadly accepted industry definitions of air-to-water heat pumps or heat pump boilers?

[1] https://www.epa.gov/system/files/documents/2022-03/fy-2022-2026-epa-strategic-plan.pdf, Goal 1, Objective 1.1

Question 3: Is there any need to distinguish boilers that are used with hydronic coils in a forced-air distribution system from those used with hydronic distribution? Are the same products used in both situations?

There is no need to distinguish between equipment used in hydronic vs. forced air distribution as this is an application issue, rather than an equipment-based distinction. However, it is worth considering whether to include testing/performance requirements for each application as this will likely result in differing performance metrics.

Question 4: EPA believes that products that can serve as domestic water heaters or as air-to-water heat pumps for space heating could simply be tested and rated for each use. Is there any need for a definitional distinction between heat pump water heaters and air-to-water heat pumps for space heating? If so, what would the distinction be?

ATWHP simply extract heat energy from the ambient air to heat water. How that hot water is utilized is an application/system design issue. In other words, any ATWHP can be used for space and/or water heating. That said, some ATWHP manufacturers strive to simplify this through dedicated ports and integrated controls on the equipment for space heating and domestic water heating. We could therefore see ENERGY STAR calling out equipment with and without this feature. I don't see it as definitional so much as helpful feature.

Packaged equipment that is designed exclusively for domestic water heating such as that already addressed through the ENERGY STAR Residential Water Heaters specification should continue to be labelled under those guidelines. Only equipment that contains an outdoor evaporator should be specified under the ATWHP category.

Question 5: EPA is interested in additional information about dual fuel boilers particularly market, cost, and performance information.

Question 6: As the evaporators are likely to be located outdoors, what range of outside air conditions are most representative to determine overall performance?

47F, 17F and 5F are all critical outdoor ambient conditions for determining heating performance over a broad geographical range. These conditions are industry-accepted for other air source heat pumps and are referenced in the ENERGY STAR specification for CAC and Heat Pump Equipment[2]. It would be desirable to additionally present the performance of the equipment at the lowest claimed operating temperature.

The European labeling clearly indicates ambient (A) and leaving water temperature (LWT) in a way that is concise and easy to understand, e.g. A47/LWT105. We recommend reproducing this in a way appropriate to applicable (e.g. Fahrenheit) units and the US market.

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[2]https://www.energystar.gov/sites/default/files/asset/document/ENERGY%20STAR%20Central%20Air%20Conditioner%20and%20Heat%20Pump%20Version%206.1%20Final%20Specification.pdf

Question 7: At very low outside temperatures, the compressors for ATWHPs and dual fuel HPs may no longer provide useful efficient heat. We assume ATWHPs will include backup heating for this circumstance. Ideally, the test method would capture this behavior and incorporate it into an estimate of annual energy use. What is the best way to include backup heat in the test method? What other testing considerations should be evaluated for performance in cold climates?

Efficiency Vermont has no stance on the inclusion of backup heat in the test method. However, it is important that test results do not confuse the performance of the air to water heat pump itself.

Question 8: How often are air-to-water heat pumps applied in combination systems that also provide domestic hot water? For these applications, can they use the test and metric for 4 domestic hot water delivery efficiency found in 10CFR Part 430 Subpart B Appendix E? Would this test fully capture the performance of the product in space and water heating modes?

Efficiency Vermont has generally not seen ATWHP used to provide domestic hot water. This adds complexity and cost to the system.

Question 9: Air-to-water heat pump systems can be designed to offer load shifting in addition to their other functions. Are there products offered that are specific to such applications? In other words, are systems that provide these functions designed and assembled on site using any air-to-water heat pump, or is there something specific about the product as it leaves the factory that enables this? Are there metrics appropriate for evaluating these capabilities in a product?

The ability to do load shifting is primarily a function of system design and not particular features of the ATWHP itself. The main system components required for load shifting are thermal storage and connected controls, and significant storage may be necessary for effective load shifting. Though some ATWHP may come prepackaged with these features, this is not necessary for utilization of the equipment in load management.

Question 10: Are their additional considerations for the test method for air-to-water heat pumps?

Question 11: Do air-to-water heat pumps generally use multiple speed, variable speed, or inverter-driven compressors? For these products, do part-load tests in AHRI 550/590 reflect field operation?

Question 12: If units are sized for design conditions, what does that mean for their part-load heating performance? What have users' experiences been in the field?

Anecdotally, an Efficiency Vermont staff member, who installed an ATWHP, sized their unit for design conditions and chose a model without variable speed. This necessitated a strategy

to pick a buffer tank on the larger side (80gal) and use a large delta T (20-25F) to reduce short cycling in the shoulder seasons.

Question 13: This test defines performance with 110F leaving water temperature. This will not provide sufficient heat when used in legacy heat exchangers, typically designed for 160- 180F water. Do manufacturers recommend using these products in retrofit situations? If so, is there anything special they recommend making sure residents have enough heat?

There are a number of strategies to address issues applicable to ATWHPs being used in retrofit applications. Existing hydronic distribution systems often need to be augmented by adding emitters (e.g. panel radiators or wall-mount fan coils). Weatherization reduces overall load and enables lower delivered water temperatures. Use of reset controls optimize the equipment performance by minimizing the water temperature delivered at any given outdoor ambient condition. Additionally, supplemental heating with electric resistance or fossil fuel boilers can be used to fill any gaps these other strategies can't fill. Although 110F LWT is not a common max water temperature for retrofit applications, both retrofit and new installations should be designed for the lowest delivered water temperature possible to optimize system performance. The ENERGY STAR specification should provide guidance on target design leaving water temperatures.

Question 14: Many hydronically-heated homes are located in cold climates in the US. Is there a need for separate criteria for cold climate ATWHPs?

It is critical that the specification has cold weather performance requirements. Whether this is done as a separate set of criteria or included in a single specification depends on the structure of the spec itself. If separate criteria are utilized, very clear messaging needs to accompany the label to avoid use of warm climate labelled equipment being installed in cold climates.

Question 15: Would it be useful for EPA to define connected criteria for air-to-water heat pumps, given that they can be deployed in systems that offer load shifting? How would the needed criteria compare to those in AHRI 1380 or AHRI 1430?

Question 16: What is the cost of air-to-water heat pump systems? Does this provide the same service (e.g., covers full heating load, provides cooling, etc.) as competing systems? What are the design and installation costs for these systems in new construction and in a replacement scenario?

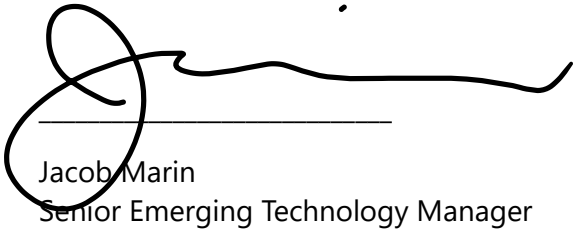
Overall installed system costs are still very high as this equipment is still considered an "emerging technology" for hydronics and heating applications in cold climates with the installer base. The supplier and installer base are still very much committed to redundancy and back up

FF equipment in general when installing this equipment. Moving the supplier and installer base to relying on the AWHP equipment to carry the full or predominant building load (and accurate building load calculations) for heating with appropriate electric resistance back-up is where the market transition still needs to occur. High overall cost for installed systems will continue to be the pattern for the near term for new construction, while retrofit applications will lag until high-temp output AWHP equipment becomes more common.

Question 17: Are there any other considerations about the implementation of an air-to-water heat pumps specification that EPA should be aware of?

There is an important distinction between "monobloc" and "split" type systems. Monobloc systems necessitate the use of glycol which has a performance impact.

Sincerely,



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