August 7, 2023

Ms. Abigail Daken
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ENERGY STAR HVAC Program
Washington, DC 20460

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RE: A. O. Smith Comments to EPA on the ENERGY STAR Residential Boilers Discussion Guide

A. O. Smith Corporation ("A. O. Smith" or "Company") appreciates the opportunity to submit comments to the U.S. Environmental Protection Agency ("EPA") regarding its June 2023 ENERGY STAR® ("ENERGY STAR") discussion guide for residential boilers. As you know, the Company is a proud ENERGY STAR program partner and prides itself on its strong working relationship with you and the Product Management team at EPA. The Company previously submitted comments on the proposal to sunset the current ENERGY STAR Program for residential boilers.

About A. O. Smith

A. O. Smith Corporation, with global headquarters in Milwaukee, Wisconsin since 1874, applies technology and energy-efficient solutions to products manufactured and marketed worldwide with operations in the U.S., Canada, China, India, Mexico, the Netherlands, Turkey, and the UK. Listed on the New York Stock Exchange (NYSE: AOS), the company is one of the world's largest manufacturers of residential and commercial water heating equipment and boilers, as well as a leading manufacturer of water treatment and air purification products. Along with its wholly owned subsidiaries, A. O. Smith is the largest manufacturer and seller of residential and commercial water heating equipment, high efficiency residential and commercial boilers, and pool heaters in North America.

Overview

Building off the Company's comments submitted on July 7, 2023[1], A.O. Smith reiterates the importance of maintaining the gas-fired boiler specification while developing and implementing a specification of Hydronic Heat Pumps (or "Air-to-Water Heat pumps" as stated in the discussion guide). As highlighted below, these products can work to complement each other to meet consumer heating needs during extreme seasons, while significantly lowering overall GHG emissions. Additionally, as EPA is aware, the Air-conditioning, Heating and Refrigeration Institute ("AHRI") is currently in the process of evaluating and developing a standard for the certification of these products. A. O. Smith encourages EPA, and the U.S. Department of Energy ("DOE") to work with AHRI in the development of a consensus industry standard.

[1] See, A. O. Smith Comments to EPA on Sunsetting the Consumer Boiler Program, submitted on July, 7, 2023

Name, Scope and Definitions

Question 1: A.O. Smith has concerns with the names "ENERGY STAR Air-to-Water Heat Pumps" and "ENERGY STAR Heat Pump Boilers".

The name Air-to-water heat pump may cause confusion given the term is used to describe heat pump water heaters and other products that extend beyond the intended scope of the specification that EPA is working to develop. A.O. Smith recommends that EPA use the term "Hydronic Heat Pumps" to describe the subset of air-to-water heat pumps that are used for space conditioning. Hydronic heat pumps operate at a lower leaving water temperature ("LVT") than conventional gas-fired boilers. Given this difference, A.O. Smith is concerned that the use of the name "Heat Pump Boiler" may inadvertently imply that these products can achieve the same leaving water temperatures as conventional boilers and therefore may be installed as direct replacements without the necessary system modifications.

Question 2: A. O. Smith is not aware of any broadly accepted industry definitions of air-to-water heat pumps.

Question 3: A. O. Smith believes that it is important to differentiate between forced air and underfloor radiant systems from conventional convective/radiator hydronics systems. The design and operation of these distribution systems are completely different and not interchangeable. Convention Hydronic Systems operate in the range of 130-160F, while forced air and underfloor radiant system operate around 110F. In a conventional hydronic system for every 40F reduction in circulating water temperature, the heat emitters need to be doubled. The final application of the products will be important to determining the optimal LVT.

Question 4: The questions posed by EPA are not clear relating to the system design being referenced and whether or not it is a combi system; a system that can be used in either domestic hot water (DWH) or space heating applications; or a system in which hot water is provide to both space heating and DWH through a single water loop. As a result of this ambiguity, the Company offers the following thoughts on each of the aforementioned designs.

Combi systems: Much like conventional combi systems, an air-to-water heat pump capable of heating both potable and non-potable water, would need to be rated to its primary functionality as a boiler.

Multiple Application HP: While it may be possible to design a product that could be installed into either a DWH loop or a Hydronic Space Heating loop, there are many constraints in the design of the system to make this possible, including, but not limited to, whether the system has an indoor or outdoor design, as well as the overall cost of the complete system. These are two important and likely barriers to interchangeable use for potable or hydronic heating.

In addition to the functional and cost related barriers, there are safety certification requirements that could add cost and limit the utility of products if they were designed and certified for both potable and hydronic installations. Features that would limit utility and add cost include:

- Low lead materials and certification for potable use.
- Maximum water temperature limits for potable water delivery.
- Temperature and pressure relief valves vs. pressure only relief valves.

- Outdoor construction and materials for hydronic heat pumps.

If an innovative product does come to market that is able to address all of these concerns, then the product should be required to be rated and certified to each of the applications that I can be used in.

Single Loop Systems: While it is theoretically possible for a system to use a single loop to provide both DWH and space heating, it is not likely that such a design would be used. Combining the historically non-potable space heating loop with the household's potable water loop would introduce new challenges. For example, the potable water heating loop and all wetted surfaces would need to be low lead and corrosion resistant. Conventional hydronic heating loops are "closed loops" that do not require corrosion resistance because the water is recirculated and contains very little free oxygen. Additionally, hydronic heating loops often include chemicals that help to prevent corrosion or fouling of internal surfaces. Safety standards prohibit connecting heating loops that have had any chemicals in them to potable systems.

To reiterate, a new combined hydronic heating and potable water systems is theoretically possible but would require the development of appropriate safety standards as well as appropriate system components. Similarly, development of appropriate dual use safety standards will be needed for these applications. The Company is not aware of any such standards development work. Given this, the Company recommends that it is too early to start discussing the efficiency rating method for this theoretical class of product.

Question 5: A.O. Smith is not aware of any products on the market that would be sold as a packaged "dual fuel boiler" as specified by EPA in the discussion guide[2]. Rather, the Company's expectation is the market will see a continuation of the typical dual-energy system currently installed today where a consumer installs an electric boiler or Hydronic Heat Pump while maintaining their existing gas-fired boiler. An advantage of a dual fuel system design would allow for the heat pump to provide heating for the majority of the year, while providing flexibility for extreme weather days where the heat pump is no longer able to keep up with the heating load of the house and allow the boiler to turn on and fill the gap. Systems of this design can also provide grid flexibility during grid events to allow for consumers to switch off electricity entirely in order to help avoid detrimental grid failures.

By way of market example, Hydro Québec has an incentive program that includes equipment rebates and lower utility rates for these types of dual-energy hydronic systems.[3] The program is designed for electricity to be used to meet over 70% of the heating requirements, and for gas systems to only be used when needed during the coldest weather. Hydro Québec has noted that heating buildings only with electricity would put significant pressure on its grid during winter peak periods and that dual energy is an excellent way of maximizing the use of electricity in building heating while limiting the impact on the grid during peak periods. It should be noted that the Hydro Québec program incentivizes adding heat pumps to existing gas systems and not dual-fuel units. Seeing that gas boilers have very long lifetimes utilizing the existing infrastructure as backup only when needed is likely to be the more

[2] Defined as "a single appliance containing an electric air-to-water heat pump and also a burner to provide backup heating capability", ENERGY STAR Residential Boiler Discussion Guide, page 3

[3] https://www.hydroquebec.com/residential/energy-wise/windows-heating-air-conditioning/dual-energy-offer/

cost-effective option. Given its high heat load and very clean grid (~94% renewable), Québec serves as a relevant example to look to as a pathway for decarbonization heating.

Test Methods

Question 6: While most heating products are evenly located across the country, boiler/hydronic heating is predominately used in the northeast. The DOE considers these states to be "cold" and "very-cold" with winter temperatures in the 0 to-35F range. Given the safety aspects associated with providing sufficient space heating it is important that these products can function at very low ambient temperatures.

Question 7: Accurately capturing the performance of these products as they would behave in the field is instrumental in ensuring confidence in the market. As such, it is imperative that the test procedure capture energy use for backup heating at low outside air temperatures. There will inevitably be innovative technology that will be able to function at low ambient temperatures without the need to revert to backup heating. However, we do not expect this to be true for applications in the market. Therefore, the test procedure should take into consideration both ends of this spectrum and not arbitrarily nor inadvertently advantage one technology over another. To avoid that outcome, the products should be tested as it would be installed in the field and allow the controls to operate as designed. Locking out the back up heat or forcing a changeover temperature in the test procedure will devalue products that can continue to operate efficiently at low ambient conditions.

Question 8: The Company is not aware of these products being commercially available in the United States. However, notwithstanding market conditions, these products should be treated in the same manner as their gas counter parts. In addition, it is important to distinguish the terminology of a combination system to mirror that of a "combi boiler", in which the system utilizes a single package and provides both potable and non-potable connections to the product. This definition should not group in appliances that are designed for space heating but can have an indirect water heater added into the system downstream. In this case the rating of the hydronics heating system should not be required to account for the indirect water heater.

Question 9: The use of water as a heating medium provides many opportunities to utilize the thermal capacity to enable load-shifting. While this could be a useful tool for utilities, there are technological concerns and considerations that need to be worked through before such functionality should be considered for an ENERGY STAR Specification. For example, the inherent advantages associated with hydronic heating should allow for more opportunity to provide grid benefit than with heating via air distribution. Unlike with air distribution, water's superior ability to conduct heat affords more efficient heat distribution and allows for the heat emitters to continue providing some heat after the unit stops running. This paired with the higher levels of occupant comfort associated with hydronic heat should provide more flexibility for grid services while maintaining user comfort than otherwise would be possible with air distribution systems.

However, when comparing the load shifting capability of Hydronic Heat Pumps to water heaters there are some key differences that should be noted. Unlike water heaters which can act as a larger thermal battery in a house, boilers typically do not have a large buffer tank that can hold preheated water for later use. Additionally, given the larger, more consistent energy draw from heating a house compared to providing hot water, it is unclear how much benefit this will provide.

The use of a smart thermostat to provide a household temperature setback could provide some benefit. However, in this case the outdoor temperature would be expected to be extremely low, and the capacity of the system could already be diminished, providing minimal benefit.

Therefore, where these products could provide the greatest benefit to the grid is when the existing gas-fired boiler is maintained and used in conjunction with the hydronic heat pump and allows for the grid to switch from pulling electricity to gas in order to maintain consistent and comfortable temperature.

Question 10: A. O. Smith has no further considerations at this time but strongly recommends EPA and DOE to work in partnership with AHRI to develop an industry consensus standard for test and rating these products.

Specification Requirements

Question 11: There is currently limited data on these products in the US market. The Company expects that the market will trend towards the use of variable speed compressors as opposed to single speed compressors. AHRI Standard 550/590 is not an appropriate standard for these products given the primary application is space cooling. Given the expected market these products would serve, it is unclear if the use of 47/17 ambient conditions as well as 105/120/140 LVT are appropriate. These products would be better served by developing test conditions from scratch with these products in mind as opposed to trying to work them into the scope of another standard. When looking at test conditions and field operation the EPA should consider looking at optional cold climate ratings and leaving water temperature rating points.

Question 12: A. O. Smith has no data on this topic.

Question 13: A. O. Smith agrees with EPA's analysis that 110F LVT will not be sufficient to work properly with legacy heat emitters. Retrofit applications will need to be evaluated on a case-by-case basis to determine the proper solution for the space. In some cases, adding additional heat emitters may be appropriate to meet the needs of the household. In other cases, there are forced air heat exchangers that are on the market that can utilize the same distribution piping and operate at lower water temperatures. These products, however, currently have limited market availability. While there are pathways forward for retrofits, these products are not a "like for like" replacement and each installation will require a custom solution to fit the need of the consumer.

Question 14: Yes, please see specification considerations outlined in the Company's response to Question 11**.**

Question 15: Please see the Company's response to Question 9.

Question 16: When compared to a gas-fired boiler, Hydronic Heat Pumps will have a significantly higher first cost for both new construction and retrofits. Retrofits would also have additional costs associated with adding or replacing existing baseboard heat emitters. In addition, retrofits also have the potential for additional costs due to panel upgrades and/or other electrical work needing to be performed as well as adding a concrete pad for the outdoor unit.

Question 17: It is important that when developing the scope of this specification that a definition is developed for residential Hydronic Heat Pumps and that there is a clear line drawn between residential and commercial products, similar to how the market is split for heat pump water heaters. This split

should consider the output heating capacity of similar products as well as limit the scope to single phase equipment in alignment with other DOE regulated products.

Conclusion

Once again, A. O. Smith appreciates the opportunity to provide comments in response to the EPA's residential boiler discussion guide. Please feel free to contact me if you have questions and the Company stands ready to work with the EPA moving forward.

Best Regards,

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