UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
AIR AND RADIATION

March 4, 2020

Dear ENERGY STAR® Commercial Dishwasher Partner or Other Interested Party:

With this letter, the U.S Environmental Protection Agency (EPA) is taking comment on a modified approach to crediting heat recovery under the upcoming Version 3.0 ENERGY STAR Commercial Dishwasher specification. Specifically, EPA is proposing to replace the energy recovery credit calculation as proposed in the Draft 2 V3.0 specification with an equation that calculates the amount of primary water heating energy offset and then subtracts that from the ASTM measured washing energy value. This proposal also includes minor modifications to the definition for heat recovery machines based on stakeholder feedback. The objective is to align the ENERGY STAR Commercial Dishwasher specification more closely with the primary domestic hot water energy use calculation in the ASTM F1696-18 and F1920-15 test methods by calculating the primary water heating energy offset by the heat recovery machine.

EPA released Draft 2 of the Version 3.0 Commercial Dishwasher specification on October 10, 2019 for stakeholder review. In response to stakeholder comments, EPA is now releasing this limited topic proposal focused on new thinking specific to the Draft 2 credit for units with heat recovery capabilities. Stakeholders may provide comments to EPA at commercialdishwashers@energystar.gov **no later than March 18, 2020**.

All comments will be posted to the ENERGY STAR product development website unless the submitter requests otherwise.

Feedback on EPA's Draft 2 Energy Recovery Credit and ASTM's Updates to F1696-18, F1920-15

EPA received feedback from stakeholders recommending that the Agency refer to the ASTM F1696-18 and F1920-15 test methods to measure the total energy consumption of heat recovery machines rather than taking measurements specific to the heat recovery system within the dishwasher, which would require an estimate or measurement of the inlet water temperature to the booster heater. However, the ASTM test methods do not currently require the inlet water temperature of the booster heater to be measured for these machines. In addition, stakeholders expressed concern over measuring the inlet water temperature to the booster heater, noting that the process for measuring this water temperature would vary among heat recovery machines. This raised repeatability issues that could result in inherent inaccuracies and potentially overestimation of the heat recovery credit proposed in Draft 2 that assumed a fixed inlet water temperature of 110°F to the booster heater. These concerns caused EPA to look more closely at the Draft 2 credit and evaluate other more suitable options for recognizing the energy savings of heat recovery machines.

Further, EPA has been tracking ASTM's progress on updating the F1696-18 and F1920-15 test methods and communicating regularly with the ASTM F26 committee chairpersons. ASTM has submitted for ballot proposed updates to the test methods, including an update to F1920-15 to align with F1696-18 to specify the temperature of the water (70±3°F) connected to the cold-water supply for heat recovery machines. This change would ensure that all heat recovery machines, as defined later in this document, follow the same test conditions and process to measure the total energy consumption including all heating devices. In addition, this change would account for the total energy consumption of heat recovery machines in a

repeatable way, allowing for comparison to non-heat recovery systems. The primary water heater energy consumed, as reported by the ASTM test method, reflects the actual hot water energy use of each machine, but is currently not included in the energy used per rack. EPA expects this updated test, with modification, to serve the intended purpose of properly crediting heat recovery machines. EPA proposes an intended use below.

Proposed Primary Hot Water Energy Offset Calculation

EPA notes that the primary hot water energy use calculation in ASTM F1696-18 and F1920-15 (section 11) is well-established but is not used for calculating energy performance. Based on the feedback from ASTM F26 committee chairpersons, EPA acknowledges a modification to this equation as a useful way to account for the difference in water inlet temperatures between heat recovery and standard commercial dishwashers. As such, the energy recovery credit described in Draft 2 will be replaced with this stakeholder recommended hot water energy offset (Equation 1). As with the credit proposed in Draft 2, this offset for eligible models would be applied once to a commercial dishwasher and subtracted from the ASTM measured washing energy value to obtain an adjusted (credited) value. Specification requirements would apply to the adjusted value (i.e., $Wash_{measured}$ - $E_{primaryoffset}$ in kWh/rack).

Hot Water Energy Offset: Calculate and report the primary hot water energy offset by the heat recovery dishwasher fed by a cold-water inlet during the washing energy rate test based on Equation 1.

Equation 1. $E_{primaryoffset} = (V_{water} \times c_p \times \rho \times (T_{instd} - T_{inhr}))/ \eta$ whereby

$E_{primaryoffset}$ = calculated primary hot water energy offset in Btu/rack (convert to kWh/rack)
V_{water} = measured water volume consumed by dishwasher in gallons/rack
c_p = specific heat of water Btu/lb*°F = 1 Btu/lb*°F
ρ = density of water in lb/gal = 8.334 lb/gal
T_{instd} = inlet water temperature to a standard (non-heat recovery) machine (per ASTM F1696-18/1920-15 section 9.3 not to exceed 140±2°F) = 140°F (in calculation)
T_{inhr} = inlet water temperature to a heat recovery machine (per ASTM F1696-18/1920-15 section 9.3 at 70±3°F) = 70°F
η = assumed commercial primary water heating system efficiency feeding dishwashers including standby and recirculation losses in % = 80% = 0.80 (in calculation)

Conceptually, this equation represents the energy the primary water heater would have used had the heat recovery not been present. According to stakeholder input, gas water heaters are more common in commercial settings (reflected in the primary hot water energy use equation for the standard dishwasher as 65%, per ASTM F1696-18 and F1920-15 Sections 11.8.4 and 11.9.4, respectively). In Equation 1, the assumed commercial primary water heating system is based on electric resistance water heaters (and associated distribution efficiency), which are more thermally efficient than gas heaters. In other words, the hot water energy offset will be lower with the assumed commercial primary electric water heater than with a gas water heater. Thus, the electric water heater assumption (i.e., 80%) is a conservative one.

Proposed Revision to Definition for Heat Recovery Machine

In addition, stakeholder comments relayed the need to revise the Draft 2 definition for heat recovery machines to ensure that all dishwashers using heat recovery mechanisms are properly identified to apply the offset equation. This revised definition is provided below.

Heat Recovery Machine: Warewashing equipment with heat recovery; a heat exchanger that recovers energy from other sources (i.e. waste water, exhaust duct) for the purpose of heating potable water. This includes but is not limited to drain water heat exchangers, wash compartment heat exchangers, exhaust heat exchangers, and supplemental heat pumps. The equipment **must meet all** the following requirements:

a. Use a minimum of 95% of water volume from the cold-water inlet for the wash and rinse cycle (the machine can have a cold- and a hot-water inlet, but a maximum of 5% of wash and rinse cycle water can come from the hot water inlet);
b. The temperature of the water at the dishwasher's inlet must be 70±3°F; and,
c. The dishwasher must operate at or above 180°F rinse temperature.

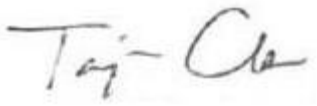
As written, part a of the heat recovery machine definition implies that most of the water entering the dishwasher's heat exchanger is coming from the cold-water inlet and a much smaller fraction is entering the dishwasher's heat exchanger from the water heater. Part b accounts for the 70°F±3 combined temperature of the cold- and hot-water inlets entering the dishwasher's heat exchanger. Finally, part c limits the definition of a heat recovery machine to high temperature machines only to exclude vapor condensing machines operating at lower rinse temperatures (i.e., 140°F) that do not use the heat recovered by condensing to reduce energy use for heating water. The EPA's understanding is that only machines with high temperature rinse provide dense enough waste heat to be worth recovering.

EPA recognizes the value of heat recovery and proposes the approach outlined above as a way to more accurately address it. EPA also appreciates the continued input of collaborators, especially ASTM, in developing this approach.

If you have comments or concerns about this proposal, **please submit them by March 18, 2020**, to commercialdishwashers@energystar.gov. Please direct any specific questions to Tanja Crk, EPA, at Crk.Tanja@epa.gov or 202-566-1037.

Thank you for your continued support of the ENERGY STAR program.

Sincerely,



Tanja Crk, Product Manager
ENERGY STAR Commercial Food Service