

Appliance Standards Awareness Project  
Alliance to Save Energy  
American Council for an Energy-Efficient Economy  
Natural Resources Defense Council  
Northwest Energy Efficiency Alliance

October 7, 2014

Ms. Brenda Edwards  
U.S. Department of Energy  
Building Technologies Program  
Mailstop EE-5B  
1000 Independence Avenue, SW  
Washington, DC 20585

**RE: Docket Number EERE–2013–BT–STD–0022/ RIN 1904–AD00: Preliminary Technical Support Document for Refrigerated Beverage Vending Machines**

Dear Ms. Edwards:

This letter constitutes the comments of the Appliance Standards Awareness Project (ASAP), Alliance to Save Energy (ASE), American Council for an Energy-Efficient Economy (ACEEE), Natural Resources Defense Council (NRDC), and Northwest Energy Efficiency Alliance (NEEA) on the preliminary technical support document (TSD) for refrigerated beverage vending machines. 79 Fed. Reg. 46379 (August 8, 2014). We appreciate the opportunity to provide input to the Department.

**We encourage DOE to incorporate variable-speed compressors in the engineering analysis.** DOE found through teardowns that a single compressor—the Embraco FFU130HAX—is widely used in beverage vending machines.<sup>1</sup> This Embraco compressor is a constant-speed compressor. We understand that beverage vending machines typically operate at part load since the refrigeration system must be designed to provide pull-down when warm beverages are loaded into the machine. DOE notes that variable-speed compressors typically use brushless permanent magnet motors,<sup>2</sup> while we understand that typical compressors used in beverage vending machines today use less-efficient capacitor-start/induction-run (CSIR) motors.<sup>3</sup> Therefore, we would expect that variable-speed compressors would be more efficient than typical compressors used in beverage vending machines at both full load and part load and could provide significant energy savings. However, DOE did not include variable-speed compressors in the engineering analysis, stating in the preliminary TSD that “DOE was unable to procure any data on the performance of refrigeration equipment using these compressors.”<sup>4</sup> We understand that Embraco offers variable-speed compressors that can be used in beverage vending machines. For example, Embraco’s website indicates that their VNEK compressors employ an inverter and can be used in

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<sup>1</sup> Preliminary TSD. p. 5-21.

<sup>2</sup> Preliminary TSD. p. 3-17.

<sup>3</sup> Based on data for Embraco FFU130HAX compressor. [http://www.embraco.com/catalog/pdfs/FT002752\\_1.pdf](http://www.embraco.com/catalog/pdfs/FT002752_1.pdf).

<sup>4</sup> Preliminary TSD. p. 5-13.

vending machine applications.<sup>5</sup> We encourage DOE to talk with Embraco and other compressor manufacturers to attempt to gather data on the performance of variable-speed compressors that can be used with beverage vending machines.

We also note that DOE's analysis of variable-speed compressors for the 2011 residential refrigerators rulemaking may provide useful information for the current beverage vending machines rulemaking. In the 2011 residential refrigerators rulemaking, DOE incorporated variable-speed compressors as a design option and obtained compressor performance data for variable-speed compressors manufactured by Embraco.<sup>6</sup>

**We encourage DOE to evaluate potential efficiency improvements from the use of hydrocarbon refrigerants.** As DOE notes in the preliminary TSD, EPA issued two notices in July 2014 proposing to ban the use of R-134a as a refrigerant for beverage vending machines and to approve the use of three hydrocarbon refrigerants—propane, isobutane, and R-441A.<sup>7</sup> DOE states in the preliminary TSD that if EPA finalizes these proposals, DOE will update its analysis, and one potential approach would be to use the existing performance curves for HFC machines as the basis for evaluating hydrocarbon machines.<sup>8</sup> However, we understand that the use of hydrocarbon refrigerants can allow for significant efficiency gains in refrigeration equipment. For example, in the 2011 residential refrigerators rulemaking, DOE noted that isobutane has a higher theoretical efficiency than R-134a,<sup>9</sup> and DOE estimated that the use of isobutane could reduce compressor power by 5% relative to R-134a.<sup>10</sup> True Manufacturing stated during the 2014 rulemaking for commercial refrigeration equipment that using propane for self-contained equipment improves efficiency by 7-11%.<sup>11</sup> And A.S. Trust & Holdings reports that Intertek tested the same refrigerator using both R-134a and R-441a and found that by using R-441a with a refrigerant charge of just 25% by weight of the R-134a charge, the refrigerator consumed 32% less power and maintained similar or colder compartment temperatures.<sup>12</sup> We encourage DOE to gather data and/or conduct modeling and/or testing to determine the potential efficiency improvements due to a switch from R-134a to hydrocarbon refrigerants.

**We support the incorporation of equipment price trends and LED price forecasting.** For the preliminary analysis, DOE projected the future price trend of beverage vending machines based on PPI data for “automatic merchandising systems, excluding parts.”<sup>13</sup> DOE also incorporated LED price projections based on DOE's 2011 Solid State Lighting R&D Multi-Year Program Plan.<sup>14</sup> The incorporation of a “learning” or “experience” curve allows the analysis to reflect the

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<sup>5</sup> <http://www.embraco.com/default.aspx?tabid=190&idcat=10&idfam=26>.

<sup>6</sup> Residential Refrigerators, Refrigerator-Freezers, and Freezers Final Rule TSD. 2011. EERE-2008-BT-STD-0012-0128. pp. 5-67 to 5-69.

<sup>7</sup> Preliminary TSD. p. 2-15.

<sup>8</sup> Preliminary TSD. p. 2-15.

<sup>9</sup> Residential Refrigerators, Refrigerator-Freezers, and Freezers Final Rule TSD. 2011. EERE-2008-BT-STD-0012-0128. p. 4-9.

<sup>10</sup> Residential Refrigerators, Refrigerator-Freezers, and Freezers Final Rule TSD. 2011. EERE-2008-BT-STD-0012-0128. p. 5-63.

<sup>11</sup> Commercial Refrigeration Equipment Preliminary TSD Public Meeting Transcript. April 19, 2011. EERE-2010-BT-STD-0003-0031. p. 152.

<sup>12</sup> <http://www.hcr188c.com/hcrProduct.aspx>.

<sup>13</sup> Preliminary TSD. p. 8-8.

<sup>14</sup> Preliminary TSD. p. 5-8 to 5-9.

observation that equipment prices tend to decrease over time, and the incorporation of LED price projections reflects the observed rapid decline in LED prices. However, we note that DOE's estimate of equipment price trends is likely to be conservative since analyzing the price trend of "automatic merchandising systems" fails to capture the price trends of the actual technologies that could be employed to improve the efficiency of beverage vending machines such as ECM fan motors, lighting and refrigeration controls, vacuum insulated panels, and variable-speed compressors. Similar to the experience with LEDs, we would expect the prices of many of these other technologies to decline much faster than the total price of beverage vending machines.

Thank you for considering these comments.

Sincerely,



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Appliance Standards Awareness Project



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