

Appliance Standards Awareness Project  
Consumer Federation of America  
National Consumer Law Center, on behalf of its low-income clients  
Natural Resources Defense Council

September 8, 2020

Mr. Bryan Berringer  
U.S. Department of Energy  
Office of Energy Efficiency and Renewable Energy  
Building Technologies Office, EE-5B  
1000 Independence Avenue SW  
Washington, DC 20585

**RE: Docket Number EERE-2014-BT-STD-0059/RIN 1904-AD97: Notice of Webinar and Availability of Preliminary Technical Support Document for Room Air Conditioners**

Dear Mr. Berringer:

This letter constitutes the comments of the Appliance Standards Awareness Project (ASAP), Consumer Federation of America (CFA), National Consumer Law Center, on behalf of its low-income clients (NCLC), and Natural Resources Defense Council (NRDC) on the notice of webinar and availability of preliminary technical support document (TSD) for room air conditioners. 85 Fed. Reg. 36512 (June 17, 2020). We appreciate the opportunity to provide input to the Department.

DOE's preliminary analysis shows that large cost-effective savings are achievable for room ACs. We believe that even greater cost-effective savings would be achievable with the incorporation of additional technology options in the analysis including alternative refrigerants and reduced evaporator air recirculation. In addition, DOE's preliminary analysis significantly underestimates the energy savings from variable-speed room ACs by not accounting for their improved part-load performance. Below we address these and other issues in the preliminary TSD.

**While we do not object to the current product classes, cost cannot be the basis for separate product classes.** In the preliminary TSD, DOE explains that the existing standards for Product Class 1 and Product Class 6 are identical to those for Product Class 2 and Product Class 7, respectively, and that therefore the Department investigated whether the existing product class differentiation is necessary.<sup>1</sup> DOE is proposing to maintain the product class distinctions "in recognition of the value to certain consumer segments of a low-cost, low-cooling capacity room AC in Product Classes 1 and 6." We do not object to maintaining these product class distinctions based on cooling capacity, but cost must not be a rationale for maintaining the distinctions. Unlike capacity, cost is not a "performance-related feature" and therefore cannot be the basis for separate product classes. Rather, any impact on product cost of potential standard levels is considered as part of the economic analysis that evaluates impacts on consumers.

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<sup>1</sup> <https://www.regulations.gov/document?D=EERE-2014-BT-STD-0059-0013>. p. 5-3. Product Classes 1 and 2 are units without reverse cycle and with louvered sides with cooling capacities of less than 6,000 Btu/h and between 6,000 and 7,999 Btu/h, respectively. Product Classes 6 and 7 are units without reverse cycle and without louvered sides with cooling capacities of less than 6,000 Btu/h and between 6,000 and 7,999 Btu/h, respectively.

**DOE should incorporate alternative refrigerants as a technology option.** In the preliminary TSD, DOE discusses the potential for alternative refrigerants including R-32, R-441A, and R-290 to improve efficiency, but ultimately did not consider them in the engineering analysis.<sup>2</sup> DOE states that the Department did not consider alternative refrigerants due to: (1) a lack of data on the potential efficiency gains because of the limited availability of room ACs on the U.S. market using alternative refrigerants; and (2) the belief that converting to alternative refrigerants could be cost prohibitive to manufacturers. However, these are not valid reasons for excluding alternative refrigerants from the analysis.

First, while DOE's preliminary analysis identified only one unit that uses R-32, room ACs using R-32 are now widely available in the U.S.<sup>3</sup> In addition, research has demonstrated the efficiency benefits for room ACs provided by alternative refrigerants including R-32 and R-290. Oak Ridge National Laboratory (ORNL) developed a high-efficiency room air conditioner to determine the viability of a window AC unit with an EER over 13.0 Btu/Wh, and found that using a "drop-in" 85% R-32 mixture as the refrigerant in place of R410A boosted efficiency by about 3%.<sup>4</sup> The report noted that pure R-32 would offer an additional efficiency gain. ORNL published a separate study where they modified a room AC unit to use propane (R-290) and demonstrated an increase in EER of 17%.<sup>5</sup> Second, while any cost impacts to consumers and/or manufacturers should of course be considered as part of the economic analysis, cost cannot be a consideration in determining what is technologically feasible. Furthermore, the wide availability of room ACs using R-32 suggests that the use of alternative refrigerants is not in fact cost prohibitive to manufacturers as DOE stated in the preliminary TSD.

**DOE should investigate how to model the potential efficiency improvement associated with reduced evaporator air recirculation.** In 2013, NREL found through laboratory testing that room AC performance degrades with evaporator air recirculation.<sup>6</sup> For new units, the study found an average decrease in cooling capacity of 7% and an average decrease in cooling COP of 8%. This degradation was even more pronounced in an older unit. NREL concluded that EER could be improved by at least 1 Btu/Wh using simple and low-cost methods such as supplying air from the bottom rather than the top of the interior face, or providing an attachment fin to separate supply and return airflows.<sup>7</sup> In the preliminary TSD, DOE mentions the results of this NREL study, but did not consider reduced evaporator air recirculation in the engineering analysis.<sup>8</sup> Given the large potential energy savings, we urge DOE to investigate how to model the efficiency improvement associated with reduced evaporator air recirculation.

**We encourage DOE to consider evaluating additional efficiency levels.** For the preliminary analysis, DOE evaluated four efficiency levels (ELs). The max-tech level (EL 4) includes the incorporation of ECM fan motors, variable-speed compressors, reduced standby power, and increases in the cabinet and heat exchanger sizes.<sup>9</sup> We encourage DOE to consider evaluating potential additional efficiency levels, including an intermediate level between EL 3 and EL 4. For example, as DOE notes in the preliminary

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<sup>2</sup> Ibid. p. 5-26.

<sup>3</sup> See, for example: <https://www.lg.com/us/air-conditioners/lg-LW6017R-window-air-conditioner>, <https://www.friedrich.com/consumer/products/chill>, <https://www.geappliances.com/appliance/GE-115-Volt-Smart-Room-Air-Conditioner-AHY08LZ>, and <https://www.haierappliances.com/appliance/specs/esaq406tz>.

<sup>4</sup> <https://info.ornl.gov/sites/publications/files/Pub53922.pdf>.

<sup>5</sup> <https://info.ornl.gov/sites/publications/Files/Pub119670.pdf>.

<sup>6</sup> <http://s3.amazonaws.com/szmanuals/f50601c1a4960b3d7627df44cc951d28>.

<sup>7</sup> Ibid. p. 35.

<sup>8</sup> <https://www.regulations.gov/document?D=EERE-2014-BT-STD-0059-0013>. p. 5-25.

<sup>9</sup> Ibid. p. 5-7.

TSD, ORNL found that replacing the conventional fan motor on a room AC with an ECM improved efficiency by 6.8%.<sup>10</sup> Since the incorporation of an ECM fan motor provides a significant efficiency gain and may represent a relatively low-cost option, DOE could consider evaluating it as a separate efficiency level. As another example, as illustrated in Table 1, the CEER levels of the most-efficient variable-speed units on the market in general fall between EL 3 and EL 4. DOE could consider evaluating efficiency levels that represent the performance of currently available variable-speed room ACs.

**Table 1. CEER values at EL 3 and EL 4 compared to the CEER values of the most-efficient variable-speed room ACs on the market**

Product Class	CEER		
	EL 3	EL 4	Most-Efficient Variable-Speed Room ACs <sup>11</sup>
3	13.9	17.9	15.0
4	13.3	17.4	14.7
5a	13.3	17.6	14.5

As described above, alternative refrigerants and reduced evaporator air recirculation offer the potential for additional efficiency gains beyond those evaluated for the preliminary TSD. We urge DOE to incorporate these technology options, either as part of efficiency levels evaluated for the preliminary TSD or as additional efficiency levels.

**DOE should capture the part-load efficiency benefit of variable-speed compressors in the energy use analysis.** In the June 2020 test procedures NOPR for room ACs, DOE proposed amendments to the test procedures for variable-speed room ACs to reflect their improved part-load performance relative to single-speed units.<sup>12</sup> Specifically, the proposed test procedure involves applying a “performance adjustment factor” to the CEER value as tested at the 95°F condition. The performance adjustment factor reflects the efficiency improvement of a variable-speed unit relative to a theoretically comparable single-speed unit across a range of outdoor temperature conditions. In the preliminary TSD, DOE explains that as part of developing the “max-tech” levels, which reflect variable-speed performance, DOE applied a performance adjustment factor to each unit based on the proposed approach in the test procedures NOPR.<sup>13</sup> However, DOE did not account for the improved part-load performance of variable-speed compressors in the energy use analysis. Rather, DOE’s calculation of energy use in cooling mode is based on EER, which reflects only full-load efficiency at an outdoor temperature of 95°F.<sup>14</sup> The energy use analysis thus only captures the small improvement in full-load efficiency of variable-speed units relative to single-speed units, while not capturing the much greater part-load savings.

Figure 1 illustrates how DOE’s approach to the energy use analysis for variable-speed room ACs significantly underestimates the savings that variable-speed units can provide. For each of the product classes analyzed in the preliminary TSD, the graph shows the expected energy savings of the max-tech

<sup>10</sup> Ibid. p. 3-30.

<sup>11</sup> [https://www.regulations.doe.gov/certification-data/#q=Product\\_Group\\_s%3A\\*](https://www.regulations.doe.gov/certification-data/#q=Product_Group_s%3A*). Accessed 8/17/20. Based on models certified using a test procedure waiver.

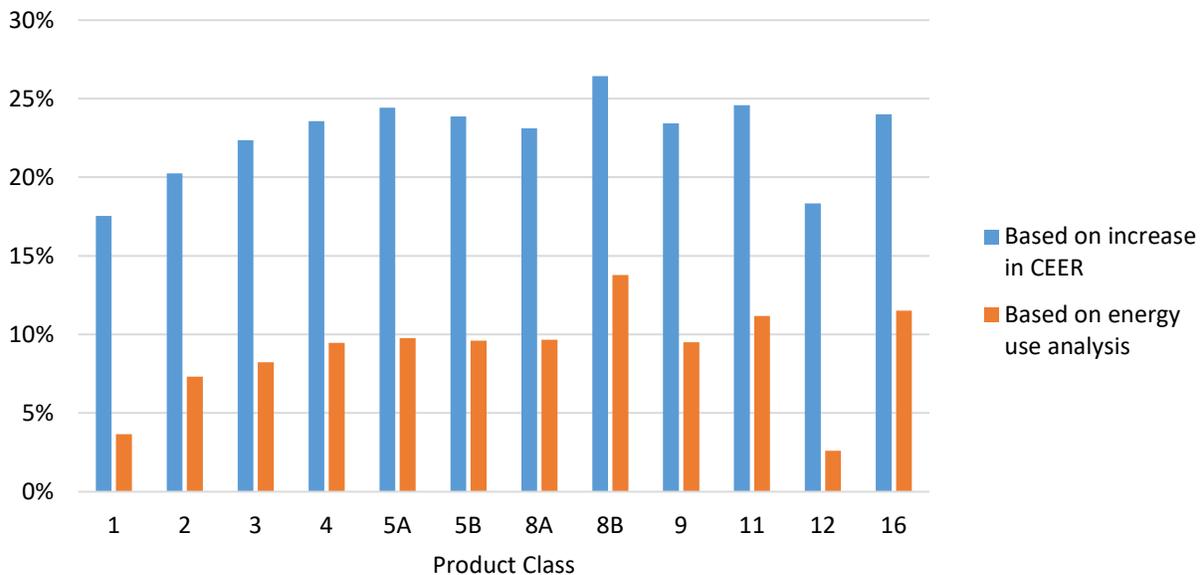
<sup>12</sup> 85 Fed. Reg. 35700 (June 11, 2020).

<sup>13</sup> <https://www.regulations.gov/document?D=EERE-2014-BT-STD-0059-0013>. pp. 5-22, 5-23.

<sup>14</sup> Ibid. p. 7-5.

level (EL 4) relative to EL 3 based on the increase in CEER,<sup>15</sup> and the energy savings at EL 4 relative to EL 3 as shown in DOE’s energy use analysis.<sup>16</sup> While the increase in CEER values would suggest energy savings of 18% to 26%, depending on the product class, the energy use analysis shows savings of just 3% to 14%. For Product Class 1, which DOE estimates represents 31% of all shipments,<sup>17</sup> the energy savings that DOE estimates at EL 4 relative to EL 3 are almost five times smaller than what the increase in CEER (12.7 to 15.4) would suggest.

**Figure 1. Energy savings of EL 4 relative to EL 3**



The preliminary TSD explains that the energy use analysis is intended to “establish a reasonable range of real-world energy consumption.”<sup>18</sup> In the real world, single-speed room ACs will experience significant cycling losses when operating at part-load conditions, as illustrated by DOE’s investigative testing for the test procedures NOPR.<sup>19</sup> In addition to significantly reducing these cycling losses, variable-speed operation improves heat exchanger effectiveness at reduced cooling loads, resulting in additional energy savings that are also illustrated by DOE’s investigative testing. Yet DOE has not captured the large part-load efficiency benefit of variable-speed room ACs in the energy use analysis. We urge DOE to revise the energy use analysis to capture the real-world savings associated with variable-speed compressors.

**We encourage DOE to investigate how the analysis could reflect learning rates associated with specific technology options.** For the preliminary analysis, DOE estimated a learning rate based on historical price data for room ACs and other HVAC equipment.<sup>20</sup> We would expect that, in general, prices of the specific technologies that are employed to improve efficiency will decline faster than the total price of the equipment. For example, we would expect that prices of variable-speed compressors will decline faster than the total price of room ACs. Therefore, DOE’s estimate of the learning rate for room ACs is likely a

<sup>15</sup> The energy savings based on the increase in CEER are calculated as  $(CEER_{EL4} - CEER_{EL3}) / CEER_{EL4}$ .

<sup>16</sup> <https://www.regulations.gov/document?D=EERE-2014-BT-STD-0059-0013>, pp. 7-25 to 7-29.

<sup>17</sup> Ibid. p. 7-8.

<sup>18</sup> Ibid. p. 7-3.

<sup>19</sup> 85 Fed. Reg. 35708.

<sup>20</sup> <https://www.regulations.gov/document?D=EERE-2014-BT-STD-0059-0013>, p. 8-10.

conservative estimate of how prices will decline over time. We encourage DOE to investigate how the analysis could reflect learning rates associated with specific technology options for room ACs. Such an approach would be similar to that taken in the 2017 final rule for ceiling fans, where DOE estimated a learning rate specific to brushless DC motors.<sup>21</sup>

**We encourage DOE to clarify how the change in shipments in the standards case was calculated.** The preliminary TSD describes a price elasticity of -0.45 and an efficiency elasticity of +0.2, and we understand that both elasticities impact the standards-case shipments.<sup>22</sup> However, the equation for calculating total shipments in the standards case includes only the price elasticity of -0.45.<sup>23</sup> We encourage DOE to confirm and clarify whether the efficiency elasticity is considered in calculating the standards-case shipments.

**DOE should consider reevaluating the use of the “roll-up” scenario for estimating the market distribution of each efficiency level following standards adoption.** In the preliminary TSD, DOE modeled a “roll-up” scenario, which assumes that “product efficiencies in the no-new-standards case that do not meet the standard under consideration would ‘roll-up’ to meet the new efficiency level.”<sup>24</sup> However, data on sales over the past decade suggest that a “roll-up” scenario will likely significantly underestimate the savings from amended standards. Figure 2 shows that in each year between 2010 and 2019, the market penetration of ENERGY STAR-qualified room ACs was more than 30%,<sup>25</sup> including in the years following the compliance date of the current DOE standard (2014). Notably, for some product classes, the current ENERGY STAR levels are higher than the max-tech levels from the last DOE final rule.<sup>26,27</sup> For example, for Product Class 1, the max-tech level from the last DOE rulemaking represented a CEER rating of 11.67, while the current ENERGY STAR specification is 12.1.

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<sup>21</sup> 82 Fed. Reg. 6854 (January 19, 2017).

<sup>22</sup> <https://www.regulations.gov/document?D=EERE-2014-BT-STD-0059-0013>, p. 9-9.

<sup>23</sup> Ibid. p. 9-10.

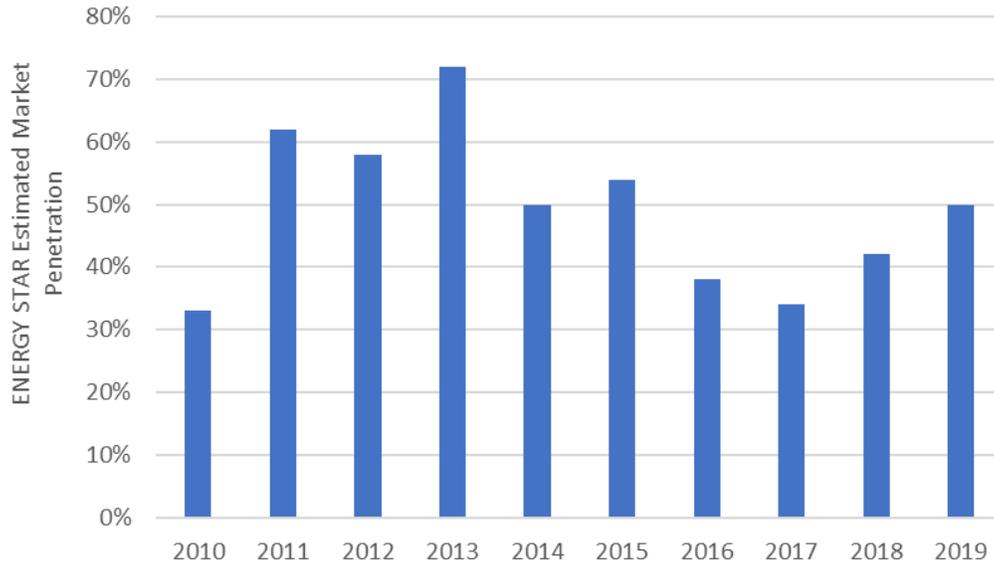
<sup>24</sup> Ibid. p. ES-34.

<sup>25</sup> [https://www.energystar.gov/partner\\_resources/products\\_partner\\_resources/brand\\_owner\\_resources/unit\\_shipment\\_data/archives](https://www.energystar.gov/partner_resources/products_partner_resources/brand_owner_resources/unit_shipment_data/archives).

<sup>26</sup> 76 Fed. Reg. 22478-79 (April 21, 2011).

<sup>27</sup> [https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Version%204.1%20Room%20Air%20Conditioners%20Specification\\_0.pdf](https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Version%204.1%20Room%20Air%20Conditioners%20Specification_0.pdf).

**Figure 2. Historical market penetration of ENERGY STAR room ACs from 2010-2019**



We would anticipate that the ENERGY STAR levels would be updated in response to amended standards, which would most likely result in an efficiency distribution that includes a significant portion of sales at efficiency levels that exceed the new minimum standard levels. We encourage DOE to consider these real-world market dynamics in order to appropriately account for the energy savings resulting from the adoption of amended standards.

Thank you for considering these comments.

Sincerely,

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