Appliance Standards Awareness Project
American Council for an Energy-Efficient Economy
Consumer Federation of America
Natural Resources Defense Council

August 21, 2023

Mr. Jeremy Dommu
U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Building Technologies Office, EE-2B
1000 Independence Avenue SW
Washington, DC 20585

RE: Docket Number EERE-2021-BT-STD-0011: Energy Conservation Standards for Ceiling Fans

Dear Mr. Dommu:

This letter constitutes the comments of the Appliance Standards Awareness Project (ASAP), American Council for an Energy-Efficient Economy (ACEEE), Consumer Federation of America (CFA), and the Natural Resources Defense Council (NRDC) on the notice of proposed rulemaking (NOPR) for ceiling fan standards. 88 Fed. Reg. 40932 (June 22, 2023). We appreciate the opportunity to provide input to the Department.

DOE's proposed standards for ceiling fans would save U.S. consumers up to about $5 billion over 30 years of sales through reduced operating costs, while providing about 0.9 quads of full-fuel cycle (FFC) energy savings.[1] While we are pleased DOE has proposed amended standards for ceiling fans, we urge the Department to adopt higher efficiency levels for both standard and hugger ceiling fans. Trial Standard Level (TSL) 4 for standard and hugger fans would result in energy savings of 3.7 quads and consumer net present value (NPV) savings of up to $21 billion, each of which are about 4-fold higher than DOE's proposed TSL 3.[2] We discuss this recommendation as well as other topics and considerations in more detail below.

We urge DOE to adopt TSL 4 for standard and hugger fans, which would provide significant additional consumer benefits, particularly for low-income households. In the NOPR, DOE has proposed to adopt TSL 3; TSL 3 is a step-function standard level for standard and hugger fans where smaller fans (less than or equal to 53") must meet efficiency level (EL) 2, which assumes use of a more efficient AC motor and/or increasing fan airflow; larger fans (greater than 53") must meet EL 4, which assumes use of a DC motor. TSL 4 represents EL 4 for all standard and hugger fan diameters. The average life-cycle cost (LCC) savings are larger at TSL 4 for standard ($40) and hugger fans ($28) compared to TSL 3 ($17 and $5, respectively).[3] Both TSL 4 and TSL 3 have similar average simple payback periods (PBPs): 4.4 and 5.7 years for standard and hugger fans, respectively, at TSL 4 and 4.1 and 6.6 at TSL 3.[4]

[1]88 Fed. Reg. 40934.
[2]Tables V.23, V.25. 88 Fed. Reg. 40995, 40996.
[3]Tables V.3, V.5. 88 Fed. Reg. 40984.
[4]Tables V.2, V.4. 88 Fed. Reg. 40983, 40984.

DOE's analysis also shows that higher standards for standard and hugger fans would provide even greater cost savings for low-income households. For low-income households, the average LCC savings at TSL 4 for standard ($53) and hugger fans ($42) are higher than those for all consumers discussed above.[5] Additionally, simple PBPs at TSL 4 for low-income households are just over half that for all consumers: 2.3 and 2.9 years for low-income households versus 4.4 and 5.7 years for all consumers.[6] DOE's analysis assumes that none of the incremental cost increase would be passed on to low-income renters who pay their energy bills.[7]

Despite TSL 4 delivering about 4x more energy and cost savings compared to TSL 3, DOE proposed TSL 3 due to concerns about impacts on low-income households at TSL 4. Low-income households face high energy burdens and are often renters with landlords who have little incentive to install efficient appliances; thus, low-income households can particularly benefit from improved energy efficiency standards.[8] However, DOE expresses concern in the NOPR that a landlord may opt against purchasing ceiling fans for tenants due to a further increase in first cost at TSL 4. In this scenario, tenants would be forced to purchase the ceiling fan themselves or become more reliant on different fan types (e.g., box fans) for comfort.[9] However, DOE's analysis shows that the incremental cost increase to move from TSL 3 to TSL 4 is $17 and $24 for standard and hugger fans, respectively. We believe that it is unlikely that a cost increase of about $20 at TSL 4 would result in a significant number of consumers foregoing the purchase of a ceiling fan.

We are also concerned that higher-income households may disproportionately accrue energy and cost savings at DOE's proposed TSL 3 relative to lower-income households. Smaller-diameter (e.g., 44") hugger fans represent the cheapest ceiling fans on the market. DOE's engineering analysis assumes that most of the efficiency improvements for smaller hugger fans will be achieved by increasing airflow rather than reducing power.[10] In other words, DOE is assuming that the purchaser of a 44" hugger fan at TSL 3 would accrue minimal energy and cost savings. Alternatively, since TSL 3 effectively requires DC motors for fan diameters above 53", purchasers of larger fans would see significant energy savings. For example, DOE's analysis shown in the Technical Support Document (TSD) estimates that the energy savings for 60" hugger fans at TSL 3 would be about 50%.[11] Low-income households are unlikely to purchase these larger fans as they are typically premium products that offer additional features as well as high efficiency. Thus, the energy and cost savings at TSL 3 would likely be disproportionately weighted towards higher income purchasers and away from low-income households that stand to benefit the most from higher standards.

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[5]Table V.10. 88 Fed. Reg. 40985, 40986.

[6]*Ibid*.

[7]88 Fed. Reg. 40972, 40973. DOE treats low-income homeowners using the same methodology applied to the overall analysis, while low-income renters who do not pay their energy bills are assumed to be unaffected by amended standards.

[8]Low-income households spend about 3.5x more of their income on energy costs (8.1%) vs. the median non-low-income household (2.3%). How High Are Household Energy Burdens? p. 9. www.aceee.org/research-report/u2006

[9]88 Fed. Reg. 41002.

[10]For example, DOE assumes that a 44" hugger fan meeting TSL 3 would on average have a 36% increase in high-speed airflow while reducing high speed input power by only 6% over a baseline fan. Table 5.7.6. TSD, p. 5-35. www.regulations.gov/document/EERE-2021-BT-STD-0011-0028

[11]Table 7.5.2. TSD, p. 7-6. www.regulations.gov/document/EERE-2021-BT-STD-0011-0028

If DOE does not adopt TSL 4 for standard and hugger fans, the Department should consider alternative proposals that drive additional savings. While we support adoption of TSL 4 for all standard and hugger fans, if DOE ultimately decides against TSL 4, we encourage the Department to consider alternative proposals that would drive additional savings compared to TSL 3. One alternative, discussed by DOE in the NOPR, would be to adopt TSL 4 for standard fans while adopting TSL 3 for hugger fans.[12] Another alternative to consider, which may provide similar additional energy and cost savings while reducing potential market distortions, would be to lower the ceiling fan diameter cut-off used in DOE's proposed TSL 3. Lowering the diameter threshold to 45" would drive substantial additional energy savings by moving most of the market, about 88% of standard fans and 58% of hugger fans, towards DC motors.[13] Meanwhile, fans at 44" or less, which make up over 40% of the hugger fan market, would remain at EL 2 under this proposal. Smaller diameter hugger fans represent the lowest cost options on the market and keeping these fans at EL 2, consistent with DOE's proposed standards, would mitigate DOE's concern about consumer impacts.

We support DOE's approach for estimating the incremental cost of ceiling fans with DC motors. DOE's cost analysis uses a combination of physical and catalog teardowns to create a bottom-up manufacturer production cost (MPC) estimate for each representative fan type/blade diameter and EL.[14] Though many DC motor ceiling fans on the market feature premium features (sleek designs, additional fan speeds, remote controls, smart connectivity, etc.) not available on baseline AC motor fans, the primary driver of increased MPCs at EL 4 in DOE's cost analysis is the cost associated with switching to a DC motor. We support this approach for capturing the incremental cost only of features directly tied to improving efficiency (i.e., switching to a DC motor) and believe DOE's analysis represents a robust estimate for the cost increase of a basic fan (e.g., with pull chain controls) under amended standards. DOE estimates that the incremental cost of a standard or hugger fan meeting TSL 4 relative to the baseline is $26-28.[15]

We support DOE's price learning assumption for DC motor electronic controllers. DOE explains in the NOPR that the primary component of the cost increase associated with DC motors is the electronic controller that controls motor operation.[16] DOE included price learning in their estimates of future prices wherein the incremental cost between the EL reflecting the highest-efficiency AC motor (EL 2) and a DC motor (EL 3) decreases over time. Consistent with the 2017 Final Rule, DOE used semiconductor Producer Price Index (PPI) data to estimate price learning for DC electronic controllers, which corresponds to a 6.5%/year price decline. Manufacturers disputed use of semiconductor price learning estimates, stating that ceiling fan power electronics differ from typical integrated circuitry electronics. Though there may be some uncertainty in the appropriate price learning rate for DC ceiling fans, we expect that costs would decrease over time as DC motors are becoming increasingly common in a variety of applications. Further, DOE evaluated an alternative scenario absent price learning and the resulting consumer NPV totals fell by less than 8%.[17] We note that price learning assumptions have a minimal impact on the LCC results, since the LCC results reflect purchases made only in the first year of compliance with amended standards.

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[12] 88 Fed. Reg. 41004.
[13] Table 8.4.1. TSD, p. 8-28. www.regulations.gov/document/EERE-2021-BT-STD-0011-0028
[14] 88 Fed. Reg. 40957.
[15] Tables V.2, V.4. 88 Fed. Reg. 40983, 40984.
[16] 88 Fed. Reg. 40970.
[17] TSD, p. 10C-2. NPVs at 3% (7%) are $19.4 ($7.2) billion versus $21.0 ($7.8) in DOE's price learning scenario. www.regulations.gov/document/EERE-2021-BT-STD-0011-0028

We support DOE's estimate of DC motor ceiling fan lifetimes. DOE's analysis assumes that the average lifetime of a ceiling fan regardless of motor type or EL is 14.6 years.[18] While manufacturers have suggested that DC motor electronic controllers may cause premature failure for DC ceiling fans, the NOPR notes that DOE is unaware of any data to corroborate a difference in DC ceiling fan lifetimes compared to ceiling fans with AC motors.[19] Further, we note that DOE includes an additional 6.8% warranty rate markup for ceiling fans with DC motors to reflect the potentially greater post-purchase support for DC motor fans;[20] while we explained in our comments on the preliminary analysis that the warranty factor may be artificially inflating the projected MPCs for ceiling fans with DC motors,[21] this added warranty rate would account for a potential increase in any premature DC motor failures.

DC ceiling fans offer similar consumer utility as AC ceiling fans. While the most basic AC ceiling fan models utilize pull-chains to control fan speed and/or lighting, some use wall controls or remote controls for operation. In addition to simple pull chain models, DOE notes in the NOPR that many DC fans on the market are sold with wall controllers or remotes and that while these controls are different from wired wall controls for AC ceiling fans, the functionality offered to consumers is the same.[22] Additionally, we understand that for installations where the consumer desires wall controls but lacks them, a DC fan whose controls are inherently wireless is a straightforward option to add this functionality. Furthermore, as DOE notes in the NOPR, many DC ceiling fans on the market today are higher-priced products that target more upscale consumers.[23] It seems unlikely that manufacturers would produce such a wide array of larger, high-end DC fans (over 50% of models 60"+ use DC motors[24]) if consumer utility was significantly impacted.

We encourage DOE to evaluate higher $CFEI_{40}$ ELs for large diameter ceiling fans (LDCFs). While DOE evaluated two ELs associated with higher $CFEI_{100}$ values (i.e., LDCF high-speed efficiency), the Department did not evaluate ELs above baseline for $CFEI_{40}$ (i.e., LDCF efficiency at ~40% fan speed). DOE notes in the NOPR that technologies that improve high-speed efficiency (i.e., $CFEI_{100}$), such as airfoil design or better transmission efficiency (e.g., permanent magnet (PM) direct drive motors), are also likely to improve the efficiency at $CFEI_{40}$;[25] therefore, DOE did not evaluate higher $CFEI_{40}$ efficiency levels, stating that $CFEI_{100}$ values tend to correlate with higher $CFEI_{40}$ values. While it may be generally true that fans meeting an amended $CFEI_{100}$ standard perform well at lower speed, LDCF ratings in DOE's Compliance Certification Database (CCD),[26] plotted in Figure 1, show a limited correlation between $CFEI_{100}$ and $CFEI_{40}$. In other words, there appears to be a large variation in low-speed efficiency for fans meeting a given $CFEI_{100}$ level. We understand that high efficiency at lower fan speeds is typical of fans that are well optimized and that certain technology options like direct-drive PM motors may benefit low speed efficiency in particular.

[18] 88 Fed. Reg. 40966.
[19] 88 Fed. Reg. 40967.
[20] 88 Fed. Reg. 40959.
[21] EERE-2021-BT-STD-0011-0025, www.regulations.gov/comment/EERE-2021-BT-STD-0011-0025
[22] 88 Fed. Reg. 40949, 40950, 40960.
[23] 88 Fed. Reg. 40958.
[24] Figure 5.7.20. TSD, p. 5-41.
[25] 88 Fed. Reg. 40952.
[26] Accessed August 3rd, 2023. www.regulations.doe.gov/certification-data/CCMS-4-Ceiling_Fans.html
Plot omits fans with $CFEI_{40}$ > 3.0 and/or $CFEI_{100}$ > 2.0, which far exceed DOE's analyzed LDCF ELs.

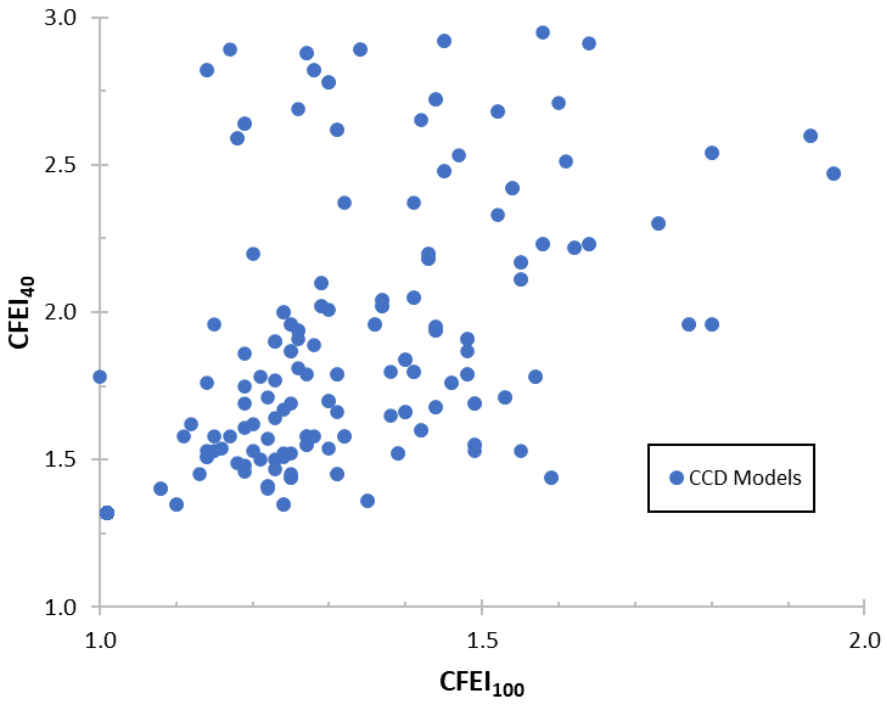

Figure 1: $CFEI_{40}$ versus $CFEI_{100}$ efficiency values for LDCFs in the CCD.

Thank you for considering these comments.

Sincerely,

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