July 16th, 2020
Via Electronic Mail

Ms. Lucy deButts
U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Building Technologies Office
EE-5B, 1000 Independence Avenue SW
Washington, DC 20585-0121

**Re: Docket Number EERE-20219-BT-TP-00013: Test Procedure for Illuminated Exit Signs Request for Information**

Dear Ms. deButts,

Northwest Energy Efficiency Alliance (NEEA) and Appliance Standard Awareness Project (ASAP) submit the following comments in response to the Department of Energy's (DOE) request for information (RFI) regarding the test procedure for illuminated exit signs: 85 Fed. Reg. 33036 (June 1, 2020).

We support DOE's efforts to update the test procedure for illuminated exit signs and also encourage DOE to open a standards rulemaking for these products. Specifically, we submit the following comments on this RFI and provide supporting documentation in Attachment A (Energy Savings Calculations).

# Comments

**1. We recommend DOE open a standards rulemaking to evaluate cost-effective savings opportunities for illuminated exit signs.**

We estimate that 0.13 quads of site energy could be cost-effectively saved through updates to DOE's illuminated exit sign standard. Updating the standard could save more than 70% of all energy use of illuminated exit signs nationwide.[1] Three indicators strongly support our recommendation:

- *The current standard levels are out of date.* The levels in the current standard were developed nearly 20 years ago when they were first adopted in California.[2] DOE never conducted its own analysis, and our research indicates there are likely untapped cost-effective energy savings opportunities for illuminated exit signs.

[1] Savings is over a thirty-year period. All calculations are of site energy. Please see the Attachment A to this letter for technical details and assumptions associated with our calculations.

[2] Standards in California were adopted in 2002. Appliance Standards Awareness Project website. "Illuminated Exit Signs." Available at: https://appliance-standards.org/product/illuminated-exit-signs, accessed 9 July 2020.

- *Exit signs can be made more efficient with current technology*. Since U.S. standards for illuminated exit signs became effective in 2006, lighting technology, power electronics and battery improvements have advanced to enable higher efficiency and lower power use. In lighting, efficacy of green and red LEDs have improved upwards of 150 percent from approximately 50 (red) and 65 (green) lumens per watt in 2004 to 140 (red) and 160 (green) lumens per watt in 2016.[3] Electroluminescent technology is already employed in some exit signs and has an even higher efficiency than LEDs.[4] In power electronics, improved efficiency of integrated circuits for ac-dc power conversion and battery charger control have been available for some time.[5,6] These power electronics components are currently sold in high numbers due to DOE's own external power supply and battery charger standards that required these cost-effective efficiency improvements.[7,8] Additionally, more efficient battery chemistries, such as lithium ion, have nearly zero self-discharge and have become cheaper and more commonplace. Lithium ion can now be considered a viable alternative to nickel-based battery chemistries that have higher self-discharge (and therefore higher battery maintenance input power). Finally, photoluminescent technologies, which absorb white ambient light, eliminate the need for a battery backup altogether in certain installation locations.[9] Altogether, the significant technological improvements that have taken place in recent decades warrant DOE's consideration for cost-effective savings opportunities.
- *More efficient technology is likely low cost.* Our analysis of the DOE Compliance Certification Database for illuminated exit signs reveals that 12% of signs operate at 1.5

[3] Pattison, P. Morgan, M. Hansen and J. Tsao. 2017."LED Lighting Efficacy: Status and Directions." p. 3. Available at: https://www.osti.gov/pages/servlets/purl/1421610. *Note:* Efficacy is calculated by taking the product of a) power conversation efficiency of red and green LEDs in 2004 and 2016 (Figure 3.c.) and b) ideal lumen output for the red (330 lumens per watt) and green (650 lumens per watt) wavelengths.

[4] An example of an exit sign employing electroluminescent technology can be found at https://www.exitlightco.com/product/LECW.html, accessed 9 July 2020.

[5] Northwest Energy Efficiency Alliance, Natural Resources Defense Council and the Appliance Standards Awareness Project comment to DOE Request for Information on External Power Supply Standards (docket EERE-2020-BT-STD-0006). 6 July 2020. Comment 1 (p. 1-3) and Comment 8 (p. 14). Available at: https://www.regulations.gov/document?D=EERE-2020-BT-STD-0006-0006.

[6] Power Sources Manufacturers Association (PSMA) comment to the California Energy Commission regarding Battery Charger Standards (Docket No. 09-AAER-2). 14 March 2011. p. 2. Available at: https://efiling.energy.ca.gov/GetDocument.aspx?tn=60027&DocumentContentId=37231, accessed 9 July 2020.

[7] 10 CFR Part 430.32(w). Available at: https://www.ecfr.gov/cgi-bin/text-idx?SID=c9dbafe3c54ecf1ee3bbb502608fca50&mc=true&node=se10.3.430_132&rgn=div8, accessed 9 July 2020.

[8] 10 CFR Part 430.32(z). Available at: https://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=7926ca54b0e2db52a0d83111eee6701b&mc=true&n=pt10.3.430&r=PART&ty=HTML#sp10.3.430.c, accessed 9 July 2020.

[9] An example of an exit sign using photoluminescent technology is the Chloride CLXARW. Available for sale at: https://www.exitsignwarehouse.com/products/esw-pl50-r?vfsku=ESW.PL50.R&gpla=pla&gclid=Cj0KCQjwgJv4BRCrARIsAB17JI7CIW6MhGZ5s2y93Ws0VIV_n8LO_B8X851l6updtEp8ngEL18uGDpoaAnulEALw_wcB, accessed 9 July 2020.

watts per face or less.[10] Many single face products incorporate LEDs and a backup battery and use as little as 0.67 watts.[11] This suggests that these more efficient technologies are already at a cost-effective point to be incorporated into today's exit signs.

Together these points illustrate that the opportunity to update exit sign standards is timely, appropriate and feasible, and we strongly urge DOE to proceed with this effort. Furthermore, a standards update could also address larger capacity batteries associated with combination illuminated exit signs. We address this point further in comment 2 below.

**2. We recommend DOE apply the current test procedure to the combination illuminated exit signs and then conduct a standards rulemaking to consider whether higher power levels are needed for larger battery backup systems found in combination units (RFI Issue 6).**
We agree with DOE that combination illuminated exit signs as defined in section II.A in this RFI are likely to require larger capacity backup batteries to enable auxiliary features in the event of a building power outage (e.g., egress lighting and audible alarms). Furthermore, we also concur with DOE that this extra functionality should be addressed by test procedures and standards for exit signs. However, the alternate test procedure DOE proposes for combination exit signs in section II.5 of this RFI is inappropriate because it 1) does not enable measurements representative of field use, and 2) creates an unfair playing field for manufacturers. We address both assertions below.

- *DOE's proposed measurement approach for combination exit signs is not representative of field use.* During exit sign installation, power is used to illuminate the face(s) and to maintain the battery backup. Power to maintain the battery can be higher or lower depending on power electronics design and the battery chemistry (see comment 1 above). This battery backup is integral to the product so that it may maintain *continuous illumination* of the exit sign in the event of a power outage. DOE proposes that combination exit signs may be disassembled prior to testing in order to isolate the power use associated with illumination of the exit sign face(s) and exclude power use associated with maintaining the charge of the backup battery. Alternatively, manufacturers would have the opportunity to test a non-combination exit sign that is "equivalent" to the combination exit sign, reporting those equivalent input power values instead. In the latter (equivalent) case, DOE proposes that the presence of a backup battery is required. However, the specific power electronics and battery size in the equivalent unit would likely be quite different from what the product actually uses in the field. We strongly disagree with both of these test procedure approaches as they would each produce measurements unrepresentative of field use of these combination exit signs.

[10] Analysis of DOE's Compliance Certification Database. Available at: https://www.regulations.doe.gov/certification-data/CCMS-4-Illuminated_Exit_Signs.html#q=Product_Group_s%3A%22Illuminated%20Exit%20Signs%22, accessed 9 July 2020.
[11] An example of one such product line is Beghelli's ATX series. Available at https://beghelliusa.com/c/products/emergency/atx-re.php, accessed 10 July 2020.

- *DOE's proposed measurement approach for combination exit signs creates an unfair playing field for manufacturers.* Under DOE's proposed approach in section II.A, power use of the battery charger system would be excluded or reduced for some combination exit signs that can be disassembled or have an equivalent product. However, power use of the battery charger system would be included for other combination exit signs that are not able to be tested in these alternate ways. Moreover, input power tests of non-combination exit signs include power use of the backup battery. To ensure a level playing field for all manufacturers, all exit signs with and without auxiliary functions (combination and non-combination units) should be subject to a test procedure that always includes power use of the battery backup. We recommend that DOE continue to include actual power use of the battery backup system for all exit signs.

Therefore, rather than making inappropriate modifications to the test procedure, we recommend that DOE require testing of combination illuminated exits signs with the current test procedure and evaluate appropriate standards levels for units with larger battery backup in a future standards rulemaking. We note that continuing to include battery backup power of all exit signs in the test procedure is consistent with the approach originally taken by the ENERGY STAR® program and DOE's current (and past) approach for the illuminated exit sign test procedure and standard. In a rulemaking, DOE could consider whether alternative standards levels (watts per face) are needed for exit signs (combination or non-combination) that have larger size capacity battery backup. Taking a more systematic and technically appropriate approach to addressing combination exit signs with a standards rulemaking will enable DOE to evaluate the cost-effective standards level associated with the latest LED, power electronics and battery technology that can be employed for larger capacity backup batteries in exit signs generally.

**3. We recommend DOE retain the current battery conditioning instructions prior to test to ensure repeatability and reproducibility of the test procedure (RFI Issue 5).**

In section II.4 of this RFI, DOE proposes to change the battery conditioning period of illuminated exit signs to remove battery discharge and recharge before test. Our market and technical research revealed that: 1) common battery chemistries in exit signs—such as nickel cadmium and nickel metal hydride—have relatively high self-discharge rates (the backup battery is likely to be partially discharged when first energized for testing), and 2) many exit signs only trickle charge the battery such that full battery recharge can take 24 hours or more.

Given these two product characteristics, we find it highly likely that energizing the exit sign for only 20 minutes immediately prior to the test (as DOE proposes in section II.4 this RFI) will lead to active battery charging during the test period. This matters because manufacturers typically have different charging algorithms, and the additional charging power measured will depend on the product being tested and the state of charge of the battery. Ultimately, we expect this approach will result in decreased repeatability and reproducibility of the exit sign test procedure. Therefore, we recommend that DOE maintain its current conditioning period for both the lighting system and the battery system, specifically: 1) require 100 hours of exit sign operation before testing procedures begin, and 2) immediately prior to input power

measurements, operate the exit sign using a battery for an additional 90 minutes and the recharge the battery for the period specified by the sign manufacturer.

**4. We support DOE's proposed updates to illuminated exit sign definitions of "face," "face count" and "combination illuminated exit sign," and we encourage DOE to expand the scope of the test procedure to include all illuminated emergency egress signs (RFI Issue 1).**
We recommend that DOE make three updates to illuminated exit sign definitions: 1) adopt DOE's proposed definition of "face" and "face count," 2) adopt DOE's proposed definition of "combination illuminated exit sign" and 3) update the test procedure to include all illuminated emergency egress signs.

- *Clarify "face" and "face count."* Our research revealed manufacturers are currently interpreting "face" and "face count" differently from DOE's proposed definition in RFI Section II.A, indicating that clarification is required.[12] DOE's proposed definitions will help ensure all manufacturers interpret these important test procedure elements in the same way, creating a level playing field. Furthermore, we support DOE's approach to define the face count as the lowest number of faces that could be configured in use, as this is most representative of the highest possible energy use per face when installed in buildings.

- *Adopt definition of "combination illuminated exit signs."* We encourage DOE to adopt its definition of "combination illuminated exit sign" as described in RFI Section II.A. This definition will increase industry clarity.

- *Update definitions in the test procedure to include all Illuminated emergency egress signs*. We recommend DOE include illuminated signs required for marking the means of building egress as defined in Section 7.10.7 of the National Fire Protection Association (NFPA) 101 Life Safety Code (2018) and ANSI/UL 924 Standard for Emergency Lighting and Power Equipment in the scope of its test procedures. Including signs that mark egress with other messages, signs and symbols would align with accepted industry standards. This recommended change would mean inclusion of emergency egress signs with messages such as "To Fire Escape" and "To Stairs" that do not contain the word "Exit," as is currently required under definitions within DOE's current test procedure.

These three recommended updates will clarify the test procedure and harmonize with other industry standards for illuminated emergency egress signage.

[12] In DOE's Compliance Certification Database, we found that some manufacturers report two faces for an exit sign that would be considered a single face exit sign under DOE's proposed definition of face and face count in this RFI. One such example is this red edge lit sign for sale at Exit Light Co. Available at: https://www.exitlightco.com/product/ELRT-R.html?gclid=Cj0KCQjwgJv4BRCrARIsAB17JI6ML3AixfZlSKrn2v9bpgybGYmY4bBmaSIjHmQMO2Eh77TniNGEGFYaAg1UEALw_wcB, accessed 9 July 2020.

**5. We recommend that DOE consider updates adopted in ENERGY STAR Version 3.0 test method for illuminated exit signs when incorporating test procedure language directly into 10 CFR 432.204 (RFI Issue 3).**

We support DOE's proposal to incorporate test procedure language directly into 10 CFR 431.204, as this will improve clarity and transparency since the ENERGY STAR program for illuminated exit signs was suspended in 2008. We recommend that DOE consider changes found in ENERGY STAR's most recent test procedure revision (March 2004) for illuminated exit signs Version 3.0.[13] Version 3.0 incorporated important updates, including required ambient temperature conditions for testing (25 ºC $\pm$ 10 ºC), specific references to industry standards (UL 924), and clarifications on inclusions of products that do not contain integral light sources (such as photoluminescent and self-luminous). These and other updates provide ample evidence for DOE's consideration for inclusion in its updated test procedure, as they represent improvements in clarity and repeatability/reproducibility of the testing process.

# Summary

We appreciate that DOE plans to update the current illuminated exit sign test procedure and that it seeks data and comments by requesting information from the public. We offer the following recommendations and thoughts concerning the illuminated exit sign test procedure and standard:

1. We recommend DOE open a standards rulemaking to evaluate cost-effective savings opportunities for illuminated exit signs.
2. We recommend DOE apply the current test procedure to the combination illuminated exit signs and then conduct a standards rulemaking to consider whether higher power levels are needed for larger battery backup systems found in combination units (RFI Issue 6).
3. We recommend DOE retain the current battery conditioning instructions prior to test to ensure repeatability and reproducibility of the test procedure (RFI Issue 5).
4. We support DOE's proposed updates to illuminated exit sign definitions of "face," "face count" and "combination illuminated exit sign," and we encourage DOE to expand the scope of the test procedure to include all illuminated emergency egress signs (RFI Issue 1).
5. We recommend that DOE consider updates adopted in ENERGY STAR Version 3.0 test method for illuminated exit signs when incorporating test procedure language directly into 10 CFR 432.204 (RFI Issue 3).

Thank you for considering our comments.

Sincerely,

[13] ENERGY STAR Version 3.0 available at: https://www.energystar.gov/index.cfm?c=archives.exit_signs_spec, accessed 13 July 2020.

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Attachment: A – Energy Savings Calculations

# Attachment A – Energy Savings Calculations

*Summary:* Estimated energy savings possible from improved exit sign standards is 0.13 quads over the next 30 years, which represents a 96% reduction in unit energy consumption (UEC). These updated standards would also reduce the site energy use of illuminated exit signs by 72% for the 30-year period.

*Methodology:* The unit energy savings (UES) is calculated as the difference between a typical LED exit sign available today[14] and a state-of-the-art electroluminescent or light-emitting capacitor (LEC) exit sign with lithium ion batteries. The latter uses only 0.2 watts per face and is available on the market today from U.S. manufacturers.[15] Lithium ion batteries use negligible energy for this application because they do not continue to draw power once the battery is fully charged.[16] Nickel-based batteries often continue to draw power even after the battery is fully charged, thus increasing the total energy consumption for those exit signs. The 96% reduction in UEC is due to the difference in energy use between typical exit signs (4.6 watts per face) and high efficiency exit signs (0.2 watts per face).

Our 30-year savings estimate is based on the exit sign population reported in the 2010 U.S. Lighting Market Characterization study,[17] an average growth rate based on commercial floorspace from the U.S. Energy Information Administration (EIA) Annual Energy Outlook[18] and an exit sign lifetime of 15 years.[19,20,21] Using these sources we project the 2020 national population of exit signs is 34.6 million units and annual shipment of illuminated exit signs is 2.3 million units. The population and shipments are further projected to 2050, and the site energy savings is measured over the lifetime of exit signs shipped in this 30-year period. The UES for exit signs is applied to new shipments of exit signs from 2021 to 2050. The national population of exit signs turns over after one lifetime (15 years) and shipments for the remainder of the 30-year period are for new construction only.

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[14] Approximately 40% of all exit signs in the DOE's Compliance Certification Database are between 4 and 5 watts per face. NEEA assumed the typical exit sign was 4.6 watts per face. Available at: https://www.regulations.doe.gov/certification-data/CCMS-4-Illuminated_Exit_Signs.html#q=Product_Group_s%3A%22Illuminated%20Exit%20Signs%22, accessed 11 July 2020.

[15] The Exit Light Co. – Electroluminescent Exit Sign. https://www.exitlightco.com/product/LECW.html.

[16] California Energy Commission (CEC) – Designing Battery Charger Systems for Improved Energy Efficiency (2006). Available at: https://www.kannahconsulting.com/wp-content/uploads/2016/08/1270_BatteryChargerTechincalPrimer_FINAL_29Sep2006-1.pdf.

[17] DOE - 2010 U.S. Lighting Market Characterization (2012). Available at: https://www1.eere.energy.gov/buildings/publications/pdfs/ssl/2010-lmc-final-jan-2012.pdf.

[18] U.S. Energy Information Administration – Annual Energy Outlook 2015, 2020. Table 5. Commercial Sector Key Indicators and Consumption. Available at: https://www.eia.gov/outlooks/aeo/data/browser/#/?id=5-AEO2020&sourcekey=0.

[19] Minnesota Technical Reference Manual (TRM) 2014 – Exit Sign Measure Lifetime. Available at: https://mn.gov/commerce-stat/pdfs/trm-1.1.pdf.

[20] Illinois Technical Reference Manual (TRM) 2017 – LED Exit Signs Measure Life. Available at: https://s3.amazonaws.com/ilsag/IL-TRM_Effective_010118_v6.0_Vol_3_Res_020817_Final.pdf.

[21] New England State Program Working Group – Measure Life Report 2007. Available at: https://library.cee1.org/sites/default/files/library/8842/CEE_Eval_MeasureLifeStudyLights&HVACGDS_1Jun2007.pdf.

To calculate percent reduction of site energy use, we compared the 30-year energy consumption of the exit sign population in a no new standards case to the improved standards case. The improved standards case models the incremental replacement of baseline efficiency exit signs (4.6 watts per face) with efficient exit signs (0.2 watts per face), and the no new standards case assumes the exit sign population remains at the baseline UEC. The reduction in site energy use of illuminated exit signs is 72% for the 30-year period and is less than the reduction in UEC because it includes the gradual stock turnover of exit signs in the 30-year period.