

ENERGY STAR Uninterruptible Power Supplies Draft 1 Version 2.0 Comment Matrix

Topic	Subtopic	Stakeholder Comment	EPA Response
Connected and Metering	Demand Response	<p>Two stakeholders commented in support of connected criteria for UPSs, citing benefits to the grid and potential technologies that could facilitate successful demand response, such as partial battery demand response in large VFI and utility bill credits for spare capacity. One stakeholder also encouraged requirements on remote management, energy reporting, grid communications, control functions, and connectivity-related information reporting.</p> <p>One stakeholder suggested that EPA consider allowing manufacturers the option of listing any applicable communications protocols for potential future demand response functionality, while another commented against providing an efficiency incentive for this functionality.</p>	EPA investigated the potential for UPSs to interconnect with the Smart Grid and to participate in demand response (DR) programs. DR capability can help balance grid loads and enable increased penetration of clean, renewable generation such as wind and solar. While EPA research has indicated that such functionality is technically feasible, EPA identified only one instance, outside of North America, where UPSs were being tapped for load balancing. If a U.S. market for grid-connected DR capable UPS starts to develop in the future, EPA may reconsider including optional connected functionality criteria.
Connected and Metering	Metering Incentive	Two stakeholders commented in support of EPA's proposal to remove allowances for energy metering, citing that the added power draw for connectivity is minimal and that metering is now a common and expected feature.	EPA thanks stakeholders for their support and has removed the metering incentive.
Connected and Metering	General	One stakeholder suggested that EPA consider developing connectivity criteria with careful consideration of how UPSs fit in a broader framework of connected technologies.	EPA will continue to monitor the market and consider use-cases for UPS connected capabilities that can save energy or help balance grid loads. EPA research indicated that virtually all UPS were "connected" with capabilities from enabling graceful client shutdown for small UPS to sophisticated capabilities in virtualized server environments that could include moving mission-critical virtual machines to enable hosts to be shut-down. EPA also found a high degree of interoperability with 3rd party UPS management software from spiceworks and NUT Project. Thus, inclusion of ENERGY STAR communication and reporting requirements is not likely to drive a significant market response.
DC Output	General	One stakeholder cautioned against splitting definitions and requirements for low and high voltage DC UPSs, citing the growing market for DC UPSs and possible fragmentation of this market due to the different requirements.	EPA's goal is to harmonize as much as possible with accepted test methods/definitions. In the case of DC UPSs EPA found that there are two different approaches, which are widely accepted as industry standard: ATIS for low-voltage and IEC for high-voltage. If these approaches are not industry standard, EPA welcomes additional comment on what is the industry standard for each product type.
Definition	VI UPSs	One stakeholder cautioned against using DOE's definition of VI UPSs, citing its inconsistency with IEC's definition which would make the distinction between VI and VFD UPSs unclear. The stakeholder suggested using IEC's definition exclusively, or limiting DOE's definition to models under DOE's scope.	As in Version 1.1, EPA has reverted to the Version 1.0 definition of VI for consistency with IEC 62040-3 and in consideration of the broad scope of the ENERGY STAR specification and the applicability of this definition to that full scope.
Efficiency Levels	Data Center VFD, VI	<p>Five stakeholders sought clarification on why the proposed efficiency level for VFD and VI UPSs with output power greater than 10 kW has decreased from Version 1.1 to Version 2.0. The rationale for the efficiency decrease was not obvious to the stakeholders, and recommended not lowering the efficiency standards without sufficient justification.</p> <p>In contrast, one stakeholder noted that the efficiency levels for VI UPSs >500kW and VFD UPSs >1500W are too high, and that there are no existing products able to meet the proposed requirements.</p>	EPA has revised the proposed efficiency requirement for VFD and VI UPSs with output power greater than 10 kW to 0.97 for VFD UPSs and 0.94 for VI UPSs. The VFD levels were reverted to the Version 1.0 levels, while the VI requirement was lowered by 0.01 in order to account for the removal of the metering incentive. In addition, the two currently ENERGY STAR certified VI UPSs >10 kW appear to meet the proposed efficiency requirements, while there are no VFD UPS >10 kW.

Efficiency Levels	General	<p>Two stakeholders commented that the proposed energy efficiency levels are too stringent, citing that the ENERGY STAR market penetration rate is not as high as EPA stated. The stakeholder recommends that EPA obtain more accurate market data before setting standards that only 25% of the market is designed to meet. One stakeholder provided recommended efficiency requirements for all UPS types based on the fact that VFD UPSs are inherently more efficient than VI UPSs which are inherently more efficient than VFI UPSs.</p> <p style="text-align: center;">Table 1: Ac-output UPS Minimum Average Efficiency Requirement</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td colspan="4" style="text-align: center;"> <p>P is the Rated Output Power in watts (W), E_{DOE} is an allowance of 0.004 for Modular VFI UPSs applicable in the commercial 1500 - 10,000 W range, and \ln is the natural logarithm.</p> </td> </tr> <tr> <th rowspan="2">Rated Output Power</th> <th colspan="3">Input Dependency Characteristic</th> </tr> <tr> <th>VFD</th> <th>VI</th> <th>VFI</th> </tr> <tr> <td>$P \leq 300$ W</td> <td>$0.00021 \times P + 0.916$</td> <td>$0.00021 \times P + 0.913$</td> <td>$0.011 \times \ln(P) + 0.822$</td> </tr> <tr> <td>$300$ W < $P \leq 1500$ W</td> <td>0.979</td> <td>0.976</td> <td></td> </tr> <tr> <td>1500 W < $P \leq 10,000$ W</td> <td></td> <td>0.970</td> <td>$0.011 \times \ln(P) + 0.822 - E_{\text{DOE}}$</td> </tr> <tr> <td>$P > 10,000$ W</td> <td>0.970</td> <td>0.950</td> <td>$0.006 \times \ln(P) + 0.866$</td> </tr> </table>	<p>P is the Rated Output Power in watts (W), E_{DOE} is an allowance of 0.004 for Modular VFI UPSs applicable in the commercial 1500 - 10,000 W range, and \ln is the natural logarithm.</p>				Rated Output Power	Input Dependency Characteristic			VFD	VI	VFI	$P \leq 300$ W	$0.00021 \times P + 0.916$	$0.00021 \times P + 0.913$	$0.011 \times \ln(P) + 0.822$	300 W < $P \leq 1500$ W	0.979	0.976		1500 W < $P \leq 10,000$ W		0.970	$0.011 \times \ln(P) + 0.822 - E_{\text{DOE}}$	$P > 10,000$ W	0.970	0.950	$0.006 \times \ln(P) + 0.866$	<p>EPA thanks stakeholders for their recommendations and has revised the proposed efficiency requirement for UPSs in Draft 2. These efficiency levels were determined based on the assumption that the DOE standards will be published and using two Version 1.0 market penetration estimates, which were based on two market reports. The levels proposed by the stakeholder were less efficient in places than the DOE standard and resulted in higher pass rates than would be acceptable for the program. Therefore, levels have been proposed that are less stringent than Draft 1, but more stringent than the stakeholder proposal.</p> <p>EPA noted the addition of unique efficiency levels for VFD and VI UPSs below 300W and believes that this approach would be appropriate for products at these rated output power levels. Therefore, EPA has incorporated that element into the Draft 2 proposal.</p>
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Efficiency Levels	Margin of Error	One stakeholder suggested that EPA consider 0.5% test equipment measuring error when setting requirements.	The Agency evaluated multiple scenarios when assessing the proposed levels that considered a range of efficiency performance for today's products as well as the impact of measurement uncertainty.																											
Efficiency Levels	Tri-mode UPS	<p>One stakeholder commented that EPA consider new UPS technologies, including automatic tri-mode UPSs.</p> <p>However, another commented that a separate efficiency calculation for UPSs with three normal modes is unnecessary, citing the lack of products in this category and the likelihood they would spend most of their time in either the highest or lowest input dependency modes and therefore be covered by existing efficiency calculations.</p>	EPA proposes to retain the current multiple-normal-mode UPS approach, pending additional data on the spread of tri-mode UPSs or their use. Under the current approach, tri-mode UPSs could be tested, but only their highest- and lowest-input-dependency modes would be used for test. This avoids the issue of selecting modes for tests in the case of more than three modes.																											
Efficiency Levels	VI and VFD - below 200W	One stakeholder commented on VFD and VI UPSs below 200 W and increasing numbers of specialized products, which leads to less efficiency. The stakeholder requested that both VI and VFD requirements be proportional with power below 300 W.	EPA revised the proposed efficiency levels for VFD and VI UPSs below 300 W to be proportional to power.																											
General	Data Quality	One stakeholder suggested that EPA investigate outliers in the ENERGY STAR Qualified Products list. Another stakeholder requested that EPA specifically investigate potential miscategorizations on the QPL.	EPA reviewed the QPL for errors and removed them from the dataset prior to the Version 2.0 analysis. EPA encourages stakeholders to notify the Agency regarding any specific errors that are identified. These may be reported to ups@energystar.gov .																											
General	DOE	Two stakeholders expressed concern that UPS Version 2.0 is too reliant on the DOE standards, citing uncertainty regarding whether the DOE final rule will actually pass. These stakeholders recommended that EPA delay UPS Version 2.0 until the DOE standards are more certain. However, a third stakeholder commented in support of aligning UPS Version 2.0 requirements with the proposed DOE standards, published or pre-published, citing that it would reduce manufacturer confusion about efficiency representations.	Stakeholders have relayed that they believe that there is reasonable certainty that the federal standard levels will be implemented. Therefore, the proposal made takes the DOE federal standards into account.																											
General	Market penetration rates	<p>Four stakeholders commented in support of the proposed specification revisions due to high market penetration estimates.</p> <p>However, two stakeholders were very concerned about the reliability of the market penetration data, citing the nearly two-fold discrepancy between different market reports. These stakeholder encouraged EPA to err on the side of caution when using market penetration rates to recommend spec revisions, and suggested waiting for more certain data to make any major revisions to the specification.</p>	EPA believes that there is agreement among stakeholders that the market penetration is above the 35% trigger for a revision. EPA worked with multiple stakeholders to increase the robustness of its dataset. Using two additional market reports, EPA estimates that the market penetration rate is likely between approximately 50% and 75%. As such, EPA considered the top quartile of the market under multiple market penetration rate scenarios when developing the Draft 2 requirements.																											
General	Non-US	One stakeholder commented that EPA should consider the specification revisions' impact on non-US, ENERGY STAR partner country markets.	EPA has modeled the pass rates of its Draft 2 proposal under multiple scenarios but did not model it for products in non-US markets. EPA has discussed the UPS proposal with other markets to assist with their own research and processes. EPA believes that the approach used to determine the Draft 2 proposal may be informative for other regions with equally limited data available.																											
Technology Improvements	Silicon Carbide (SiC) and Gallium Nitride (GaN)	One stakeholder recommended that EPA consider new UPS technologies, including very high frequency switching using SiC and GaN transistors.	After reviewing manufacturer literature, it appears that only three manufacturers currently utilize Silicon Carbide (SiC) transistors, with two reporting performance that is consistent with the mainstream Silicon (Si) technology. EPA will continue to monitor the changes in technology in the market over the lifetime of the specification.																											
Technology Improvements	Modular UPS	One stakeholder recommended that EPA consider new UPS technologies, including modular UPSs.	EPA has retained the modular allowance in Draft 2.																											

Loading Assumptions	Consumer VFD 0 - 25%	<p>Five stakeholders commented requesting the addition of 0%, 5%, and 10% load points to efficiency testing for VFD UPSs, arguing that the lack of measurement points under the 25% load level is not representative of the actual usage patterns of VFD UPSs. These stakeholders claim that these UPSs tend to be used for computer systems that operate at the 3-10% load the majority of the time. One stakeholder commented that this would not increase the testing burden for manufacturers, and therefore there are no major downsides.</p> <p>In addition, two stakeholders suggested that the weighting for the 25% load point for VI and VFIs be updated to 0.25. The stakeholders mentioned that the current suggested weighting of 0 for the 25% load point is not representative of the typical use pattern for these UPS types, citing that the most common applications - servers and virtual machines - spend the majority of their time idling.</p> <p>By contrast, one stakeholder commented that weighting factors be maintained for all UPS sizes and categories due to the lack of field data, and wait for more data to become available as systems become increasingly cloud connected.</p>	<p>EPA agrees that UPSs can be very lightly loaded, with some recent data revealing an average load of 1% for a sample of enterprise servers. However, rather than performing additional tests, which would increase burden, EPA recommends that stakeholders perform quadratic interpolation using the currently reported data. EPA can provide feedback on how its own analysis was conducted using quadratic interpolation. EPA compared measured versus interpolated data for 10 models provided by a manufacturer, and found that the average percentage difference between the two methods was -0.05% for the 5% and 10% loading points, with a minimum of -0.7%.</p> <p>EPA also proposes to keep the weightings as-is pending more representative usage data.</p>
Test Method	General	<p>One stakeholder commented in support of harmonization of test methods with the DOE test method. Another stakeholder requested clarification on why the battery is not connected during the ENERGY STAR test method.</p>	<p>EPA thanks stakeholders of their support for harmonizing test methods with the DOE test method. For products within the scope of the DOE Test Procedure, the battery must be connected for testing. However, for UPSs outside of the scope of the DOE Test Procedure, the ENERGY STAR test method does not require the battery to be connected during testing because of the associated burden (both testing and cost) for these large systems.</p>
Test Method	Humidity	<p>One stakeholder requested that the specification explicitly state that there are no humidity requirements for testing, citing logistical difficulties and limited impact on efficiency. Further discussions revealed that the 20–80% humidity range required by International Electrotechnical Commission (IEC) standard 62040-3 (referenced by the test method) is difficult to achieve in winter or in tropical climates. However, this lack of control will not significantly impact efficiency testing as temperature has a much larger impact than relative humidity on the thermal conductivity of air over the 20–30 °C range required for testing, per P.T. Tsilingiris, "Thermophysical and transport properties of humid air at temperature range between 0 and 100 °C", <i>Energy Conversion and Management</i>, 49 (2008) 1098–1110. For these reasons, manufacturers are also planning to remove the requirement during the next revision of IEC 62040-3.</p>	<p>Due to the limited impact of relative humidity on thermal conductivity of air over the required temperature range, EPA proposes to explicitly remove the humidity requirement from the test procedure for products that are outside the scope of the DOE Test Procedure. Products that are still within the scope of the DOE Test Procedure must still abide by all requirements within the DOE Test Procedure.</p>
Test Method	Hybrid systems	<p>One stakeholder commented that testing requirements currently do not adequately cover hybrid AC- and DC-output UPSs, and recommended that EPA consider loading AC and DC outputs simultaneously during testing.</p>	<p>As these types of hybrid products are not yet prevalent on the market, EPA proposes to exclude hybrid UPSs that can deliver more than 10% of their rated output power through both AC- and DC-output and to keep the testing requirements unchanged.</p>