ENERGY STAR® Program Requirements Product Specification for Uninterruptible Power Supplies (UPSs)

Eligibility Criteria Draft 2, Version 2.0

Following is the Draft 2, Version 2.0 ENERGY STAR Product Specification for Uninterruptible Power Supplies (UPSs). A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

1 DEFINITIONS

For the purpose of this specification the following definitions apply:

A) Uninterruptible Power Supply (UPS)[1]: Combination of convertors, switches, and energy storage devices (such as batteries) constituting a power system for maintaining continuity of load power in case of input power failure.[2]

1) Power conversion mechanism:

a) Static UPS: UPS where solid-state power electronic components provide the output voltage.

b) Rotary UPS: UPS where one or more electrical rotating machines provide the output voltage.

i. Rotary UPS (RUPS) without Diesel: A rotary UPS that does not contain an integral diesel engine to supply power to the load during an input power failure.

ii. Diesel-coupled rotary UPS (DRUPS): A rotary UPS that contains an integral diesel engine that may be used to supply power to the load during an input power failure.

2) Power Output:

a) Alternating Current (Ac)-output UPS: UPS that supplies power with a continuous flow of electric charge that periodically reverses direction.

b) Direct Current (Dc)-output UPS: UPS that supplies power with a continuous flow of electric charge that is unidirectional.

i. Low-voltage Dc-output UPS/Rectifier: A Dc-output UPS with output voltage less than or equal to 60 V. Includes both individual rectifier units for dc applications and entire Dc-output UPS frames or systems, consisting of rectifier modules, controllers, and any other supporting components.

ii. High-voltage Dc-output UPS: A Dc-output UPS with output voltage greater than 60 V.

Note: Dc-output UPSs are also known as rectifiers. A rectifier is a product that converts alternating current to direct current to supply a load and an energy storage mechanism. For the purposes of this document, the term “Low-voltage Dc-output UPS/Rectifier” is used because a “rectifier” may also refer to an ac-output UPS subsystem.

[1] 10 CFR 430, Subpart B, Appendix Y, Section 2.27, with modifications.
[2] Input power failure occurs when voltage and frequency are outside rated steady-state and transient tolerance bands or when distortion or interruptions are outside the limits specified for the UPS.

B) Modular UPS: A UPS comprised of two or more single UPS units, sharing one or more common frames and a common energy storage system, whose outputs, in Normal Mode of operation, are connected to a common output bus contained entirely within the frame(s). The total quantity of single UPS units in a modular UPS equals “n + r” where n is the quantity of single UPS units required to support the load; r is the quantity of redundant UPS units. Modular UPSs may be used to provide redundancy, to scale capacity or both.

C) Redundancy: Addition of UPS units in a parallel UPS to enhance the continuity of load power, and classified as follows.

1) N + 0: UPS that cannot tolerate any failures while maintaining Normal Mode operation. No redundancy.

2) N + 1: Parallel UPS that can tolerate the failure of one UPS unit or one group of UPS units while maintaining Normal Mode operation.

3) 2N: Parallel UPS that can tolerate the failure of one half of its UPS units while maintaining Normal Mode operation.

D) UPS Operational Modes:

1) Normal Mode: Stable mode of operation that the UPS attains under the following conditions:

a) Ac input supply is within required tolerances and supplies the UPS.

b) The energy storage system remains charged or is under recharge.

c) The load is within the specified rating of the UPS.

d) The Bypass is available and within specified tolerances (if applicable).

2) Stored Energy Mode: Stable mode of operation that the UPS attains under the following conditions:

a) Ac input power is disconnected or is out of required tolerance.

b) All power is derived from the energy storage system or, in the case of a DRUPS, from the integrated Diesel engine or a combination of both.

c) The load is within the specified rating of the UPS.

3) Bypass Mode: Mode of operation that the UPS attains when operating the load supplied via the Bypass only.

E) UPS Input Dependency Characteristics:

1) Voltage and Frequency Dependent (VFD) UPS[3]: A UPS that produces an ac output where the output voltage and frequency are dependent on the input voltage and frequency.[4]

2) Voltage Independent (VI) UPS[5]: Capable of protecting the load as required for VFD, above, and in addition from:

a) Under-voltage applied continuously to the input; and

b) Over-voltage applied continuously to the input[6]

[3] 10 CFR 430, Subpart B, Appendix Y, Section 2.27.1
[4] This UPS architecture does not provide both over and under-voltage corrective functions like those in voltage independent and voltage and frequency independent systems.
[5] 10 CFR 430, Subpart B, Appendix Y, Section 2.27.3
[6] An output voltage tolerance band narrower than input voltage window shall be defined by the manufacturer. The output of the VI UPS is dependent on ac input frequency and the output voltage shall remain within prescribed voltage limits (provided by additional corrective voltage functions, such as those arising from the use of active and/or passive circuits).

Note: EPA 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.

3) Voltage and Frequency Independent (VFI)[7]: A UPS where the device remains in normal mode producing an ac output voltage and frequency that is independent of input voltage and frequency variations and protects the load against adverse effects from such variations without depleting the stored energy source.

F) Single-normal-mode UPS: A UPS that functions in Normal Mode within the parameters of only one set of input dependency characteristics. For example, a UPS that functions only as VFI.

G) Multiple-normal-mode UPS: A UPS that functions in Normal Mode within the parameters of more than one set of input dependency characteristics. For example, a UPS that can function as either VFI or VFD.

H) Bypass: Power path alternative to the ac converter.

1) Maintenance Bypass (path): Alternative power path provided to maintain continuity of load power during maintenance activities.

2) Automatic Bypass: Power path (primary or stand-by) alternative to the indirect ac converter.

a) Mechanical Bypass: control is via a switch with mechanically separable contacts.

b) Static Bypass (electronic bypass): control is via an electronic power switch, for example transistors, thyristors, triacs or other semiconductor device or devices.

c) Hybrid Bypass: control is via switch with mechanically separable contacts in combination with at least one controlled electronic valve device.

I) Reference Test Load: Load or condition with a power factor of greater than 0.99 in which the output of the UPS delivers the active power (W) for which the UPS is rated.[8]

J) Unit Under Test (UUT):

1) For UPSs capable of operating at 115 V and 60 Hz that use National Electrical Manufacturer Association (NEMA) 1-15P or 5-15P plug[9]: The combination of the UPS and battery being tested[10].

2) For all other UPSs: The UPS undergoing the test, configured as though for shipment to the customer, and including any accessories (e.g., filters or transformers) necessary to meet the test setup as specified in Section 3 of the ENERGY STAR Test Method.

K) Power Factor: Ratio of the absolute value of active power *P* to the apparent power *S.*

L) Product Family: A group of product models that are (1) made by the same manufacturer, (2) subject to the same ENERGY STAR certification criteria, and (3) of a common basic design. For UPSs, acceptable variations within a product family include:

1) Number of installed modules;

2) Redundancy;

3) Type and quantity of input and output filters;

4) Number of rectifier pulses;

[7] 10 CFR 430, Subpart B, Appendix Y, Section 2.27.2
[8] 10 CFR 430, Subpart B, Appendix Y, Section 2.24
[9] 10 CFR 430, Subpart B, Appendix Y, Section 1, reworded
[10] 10 CFR 430, Subpart B, Appendix Y, Section 2.28, reworded

5) Energy storage system capacity;

6) For any diesel coupled rotary UPS, the diesel engine's make, model, and capabilities may vary. If sold in the US, the engine of the representative model must meet the requirements in Section 3.5 below; and

7) Software or jumper settings that affect rated output power.

Note: Following requests and questions from stakeholders on the Version 1.0 and 1.1 specifications, EPA proposes to expand the product family definition to include variations in software or jumper settings that permit the same UPS design to provide different rated output power and be sold as separate models. As all the models in the product family use identical components, their efficiency is believed to be predictable. Therefore, EPA expects this change to reduce testing burden while still providing a high level of assurance that models listed on the ENEGY STAR Product Finder meet the eligibility criteria. Further instructions on testing these product families have been proposed in Section 4.2.1.

M) Abbreviations:

1) A: Ampere
2) ac: Alternating Current
3) dc: Direct Current
4) DRUPS: Diesel coupled rotary UPS
5) RUPS: Rotary UPS
6) THD: Total Harmonic Distortion
7) UPS: Uninterruptible Power Supply
8) UUT: Unit Under Test
9) V: Volt
10) VFD: Voltage and Frequency Dependent
11) VFI: Voltage and Frequency Independent
12) VI: Voltage Independent
13) W: Watt
14) Wh: Watt-hour

2 SCOPE

2.1 Included Products

2.1.1 Products that meet the definition of an Uninterruptible Power Supply (UPS) as specified herein including Static and Rotary UPSs and Ac-output UPSs and Dc-output UPSs/Rectifiers are eligible for ENERGY STAR certification, with the exception of products listed in Section 2.2. Products eligible for certification under this specification include:

i) Consumer UPSs intended to protect desktop computers and related peripherals, and/or home entertainment devices such as TVs, set top boxes, DVRs, Blu-ray and DVD players;

ii) Commercial UPSs intended to protect small business and branch office information and communication technology equipment such as servers, network switches and routers, and small storage arrays;

i) Data Center UPSs intended to protect large installations of information and communication technology equipment such as enterprise servers, networking equipment, and large storage arrays; and,

ii) Telecommunications Dc-output UPSs/Rectifiers intended to protect telecommunication network systems located within a central office or at a remote wireless/cellular site.

2.2 Excluded Products

2.2.1 Products that are covered under other ENERGY STAR product specifications are not eligible for certification under this specification. The list of specifications currently in effect can be found at www.energystar.gov/products.

2.2.2 The following products are not eligible for certification under this specification:

i. Products that are internal to a computer or another end-use load (e.g., battery-supplemented internal power supplies or battery backup for modems, security systems, etc.);

ii. Industrial UPSs specifically designed to protect critical control, manufacturing, or production processes or operations;

iii. Utility UPSs designed for use as part of electrical transmission and distribution systems (e.g. electrical substation or neighborhood-level UPSs);

iv. Cable TV (CATV) UPSs designed to power the cable signal distribution system outside plant equipment and connected directly or indirectly to the cable itself. The “cable” may be coaxial cable (metallic wire), fiber-optic, or wireless (e.g., “Wi-Fi”);

v. UPSs designed to comply with specific UL safety standards for safety-related applications, such as emergency lighting, operations or egress, or medical diagnostic equipment; and,

vi. UPSs designed for mobile, ship board, marine or airborne applications.

vii. Hybrid UPSs that can deliver more than 10% of their rated output power through both ac and dc outputs.

Note: EPA received comments that the current test method currently does not adequately cover hybrid AC- and DC- output UPSs. 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 outputs.

3 CERTIFICATION CRITERIA

3.1 Significant Digits and Rounding

3.1.1 All calculations shall be carried out with actual measured (unrounded) values. Only the final result of a calculation shall be rounded.

3.1.2 Unless otherwise specified, compliance with specification limits shall be evaluated using exact values without any benefit from rounding.

3.1.3 For UPSs capable of operating at 115 V and 60 Hz that use NEMA 1-15P or 5-15P plug, calculated efficiency values shall be rounded to one tenth of a percentage point, as specified in Section 4.3.5 of Appendix Y to Subpart B of 10 CFR 430 .

3.1.4 Directly measured or calculated values that are submitted for reporting on the ENERGY STAR website shall be rounded to the nearest significant digit as expressed in the corresponding specification limit.

3.2 Energy Efficiency Requirements for Ac-output UPSs

3.2.1 Single-normal-mode UPSs: Average loading-adjusted efficiency (Eff_{AVG}), as determined per Appendix Y to Subpart B of 10 CFR 430, or if not applicable, as calculated per Equation 1, shall be greater than or equal to the Minimum Average Efficiency Requirement (Eff_{AVG_MIN}), as determined per Table 2, for the specified rated output power and input dependency characteristic.

Equation 1: Calculation of Average Efficiency for Ac-output UPSs and High-voltage Dc-output UPSs

$$Eff_{AVG} = t_{25\%} \times Eff|_{25\%} + t_{50\%} \times Eff|_{50\%} + t_{75\%} \times Eff|_{75\%} + t_{100\%} \times Eff|_{100\%}$$

Where:

- *Eff_{AVG} is the average loading-adjusted efficiency,*
- *$t_{n\%}$ is the proportion of time spent at the particular n% of the Reference Test Load, as specified in the loading assumptions in Table 1, and*
- *$Eff|_{n\%}$ is the efficiency at the particular n% of the Reference Test Load, as measured according to the ENERGY STAR Test Method.*

Table 1: Ac-output UPS Loading Assumptions for Calculating Average Efficiency

Rated Output Power, *P*, in watts (W)	Input Dependency Characteristic	Proportion of Time Spent at Specified Proportion of Reference Test Load, $t_{n\%}$			
		25%	50%	75%	100%
***P* ≤ 1500 W**	VFD	0.2	0.2	0.3	0.3
	VI or VFI	0	0.3	0.4	0.3
1500 W < *P* ≤ 10,000 W	VFD, VI, or VFI	0	0.3	0.4	0.3
***P* > 10,000 W**	VFD, VI, or VFI	0.25	0.5	0.25	0

Table 2: Ac-output UPS Minimum Average Efficiency Requirement

Minimum Average Efficiency Requirement (Eff_{AVG_MIN}), Where:
• *P* is the Rated Output Power in watts (W),
• E_{MOD} is an allowance of 0.004 for Modular UPSs applicable in the commercial 1500–10,000 W range, and
• ln is the natural logarithm.

Rated Output Power	Input Dependency Characteristic		
	VFD	VI	VFI
***P* ≤ 300 W**	$7.3 \times 10^{-5} \times P + 0.96$	$1.4 \times 10^{-4} \times P + 0.938$	$0.011 \times \ln(P) + 0.824$
300 W < *P* ≤ 1500 W	0.982	0.984	
1500 W < *P* ≤ 10,000 W	0.981 - E_{MOD}	0.983 - E_{MOD}	$0.0145 \times \ln(P) + 0.800 - E_{MOD}$
***P* > 10,000 W**	0.970	0.940	$0.0058 \times \ln(P) + 0.886$

Note: EPA has revised the proposed efficiency requirement for UPSs in Draft 2. Stakeholders provided comments on concerns related to the ENERGY STAR dataset, market penetration estimates, and the assumption that the Department of Energy (DOE) federal standards would be adopted.

In response, EPA worked with multiple stakeholders to increase the robustness of its dataset. After assessing two additional market reports, EPA believes that the market penetration rate is likely between 50% and 75%. Recognizing that the EPA dataset does not represent the performance of numerous products on the market today, the Agency evaluated multiple scenarios when assessing the proposed levels that considered a range of efficiency performance for today's products. In addition, EPA also considered the impact of measurement uncertainty in the test method. EPA has assumed that the federal rule will go into effect based on the most recent conversations with stakeholders. Considering each of these variables, EPA is proposing levels that would recognize roughly the top quartile of the market. EPA conducted an initial savings analysis and determined that the proposed criteria would save approximately $37–$2,383/year for the most common product types on the ENERGY STAR certified product list. In Draft 2, EPA revised the proposed efficiency levels for VFD and VI UPSs below 300 W to be proportional to power. In addition, 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. EPA has maintained these levels as there are very few data points in these product categories. Both VI UPSs >10 kW that are currently ENERGY STAR certified appear to meet the proposed efficiency requirements. EPA is not aware of any VFD UPS >10 kW products.

EPA took into account stakeholder comments regarding wide-bandgap semiconductor technology. 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.

3.2.2 Multiple-normal-mode UPSs that Do Not Ship with the Highest Input Dependency Mode Enabled by Default: If the Multiple-normal-mode UPS does not ship with its highest input dependency mode enabled by default, its average loading-adjusted efficiency (Eff_{AVG}), as calculated per Equation 1, shall be greater than or equal to:

i. The Minimum Average Efficiency Requirement (Eff_{AVG_MIN}), as determined per Table 2, for the rated output power and lowest input dependency mode provided by the UPS.

3.2.3 Multiple-normal-mode UPSs that Ship with the Highest Input Dependency Mode Enabled by Default: If the Multiple-normal-mode UPS does ship with its highest input dependency mode enabled by default, its average loading-adjusted efficiency (Eff_{AVG}), as calculated per Equation 2, shall be greater than or equal to:

i. The Minimum Average Efficiency Requirement (Eff_{AVG_MIN}), as determined per Table 2 for the rated output power and lowest input dependency mode provided by the UPS.

Equation 2: Calculation of Average Efficiency for Multiple-normal-mode Ac-output UPSs

$$Eff_{AVG} = 0.75 \times Eff_{LOW} + 0.25 \times Eff_{HIGH}$$

Where:

- *Eff_{AVG} is the average loading-adjusted efficiency,*
- *Eff_{LOW} is the average loading-adjusted efficiency in the lowest input dependency mode (i.e., VFI or VI), as calculated per Equation 1, and*
- *Eff_{HIGH} is the average loading-adjusted efficiency in the highest input dependency mode (i.e., VFD), as calculated per Equation 1.*

3.3 Energy Efficiency Requirements for Dc-output UPSs/Rectifiers

3.3.1 High-voltage Dc-output UPSs: Average loading-adjusted efficiency (Eff_{AVG}) for High-voltage Dc-output UPSs/Rectifiers, as calculated per Equation 1, shall be greater than or equal to the Minimum Average Efficiency Requirement (Eff_{AVG_MIN}), in Table 3, subject to the following requirement.

i. High-voltage Dc-output UPSs shall be treated as VFI when referencing Table 1.

3.3.2 Low-voltage Dc-output UPSs/Rectifiers: Average loading-adjusted efficiency (Eff_{AVG}) for Low-voltage Dc-output UPSs/Rectifiers, as calculated per Equation 3 shall be greater than or equal to the Minimum Average Efficiency Requirement (Eff_{AVG_MIN}), in Table 3. This requirement shall apply to complete systems and/or individual modules. Manufacturers can qualify either, subject to the following requirements:

i. Complete systems that are also modular shall be certified as Modular UPS Product Families with a particular model of module installed,

ii. Certification of individual modules will have no bearing on the certification of modular systems unless the entire systems are also certified as specified above.

Equation 3: Calculation of Average Efficiency for Low-voltage Dc-output UPSs

$$Eff_{AVG} = \frac{Eff|_{30\%} + Eff|_{40\%} + Eff|_{50\%} + Eff|_{60\%} + Eff|_{70\%} + Eff|_{80\%}}{6}$$

Table 3: High Voltage Dc-output UPS and Low-voltage Dc-output UPS/Rectifier Minimum Average Efficiency Requirement

Minimum Average Efficiency Requirement (Eff_{AVG_MIN})
0.955

3.4 Power Factor Requirements

3.4.1 The measured input power factor at 100 percent of the Reference Test Load shall meet the minimum level specified in Table 4: UPS Minimum Input Power Factor Requirement for all VFI and VI Normal Modes required for certification.

Table 4: UPS Minimum Input Power Factor Requirement

Minimum Power Factor Requirement
0.90

Note: EPA has removed the metering incentive. In addition, connected and metering criteria have been moved into the Considerations for Future Development section of the specification.

3.5 Diesel Coupled Rotary UPS Emissions Requirements

3.5.1 Diesel coupled rotary UPS systems intended for sale in the US must demonstrate that their diesel engines are in compliance with Clean Air Act regulations, 40 CFR part 60 subpart IIII. Compliance shall be demonstrated via presentation of a certificate of conformity with this regulation at the time of certification.

i. Systems intended for sale outside the US are not subject to this requirement.

ii. Only the representative model(s) for testing, as specified in Section 4.2, shall demonstrate compliance with Clean Air Act regulations.

4 TESTING

4.1 Test Methods

4.1.1 When testing UPSs, the test methods identified in Table 5 shall be used to determine ENERGY STAR certification.

Table 5: Test Methods for ENERGY STAR Certification

Product Type	Test Method
UPSs capable of operating at 115 V and 60 Hz that use NEMA 1-15P or 5-15P plug	Uniform Test Method for Measuring the Energy Consumption of Battery Chargers incorporated in Appendix Y to Subpart B of 10 CFR 430, Section 4: Testing Requirements for Uninterruptible Power Supplies
All other UPSs	ENERGY STAR Test Method for Uninterruptible Power Supplies, Rev. Aug-2017.

4.2 Number of Units Required for Testing

4.2.1 Representative Models shall be selected for testing by either the sampling requirements defined in 10 CFR 429.25, which references 10 CFR 429.11, or the following requirements:

i. For certification of an individual product model, a product configuration equivalent to that which is intended to be marketed and labeled as ENERGY STAR is considered the Representative Model;

ii. For certification of a Modular UPS Product Family where models vary by number of installed modules or Product Family where models vary by software or jumper settings that affect rated output power, the manufacturer shall select the maximum and minimum configurations to serve as Representative Models—i.e., the system shall meet the eligibility criteria in both its maximum and minimum non-redundant configurations. If the maximum and minimum configuration Representative Models meet the ENERGY STAR certification criteria at their respective output power levels, all intermediate configuration models within a Modular or software- or jumper-set UPS Product Family may be certified to ENERGY STAR.

Note: EPA has expanded the instructions for selecting Representative Models of a Modular Product Family to also apply to product families with differences in output power depending on software or jumper settings. In both cases, the minimum and maximum configuration shall be considered Representative Models, with intermediate configurations certified as additional models within the Product Family.

iii. For certification of a UPS Product Family where the models are related by a characteristic other than the number of installed modules or software or jumper settings, the highest energy using configuration within the Product Family shall be considered the Representative Model with the exception of energy storage system variations—the manufacturer may select any energy storage system for the test, within the requirements of the ENERGY STAR Test Method. Other products within a Product Family do not have to be tested for certification, but they are expected to meet relevant ENERGY STAR certification criteria and may be subject to verification testing sometime after initial certification.

4.2.2 A single unit of each Representative Model shall be selected for testing.

4.2.3 All tested units shall meet ENERGY STAR certification criteria.

5 EFFECTIVE DATE

5.1.1 Effective Date: The Version 2.0 ENERGY STAR UPS specification shall take effect on **Month xx, 2018**. To qualify for ENERGY STAR, a product model shall meet the ENERGY STAR specification in effect on its date of manufacture. The date of manufacture is specific to each unit and is the date on which a unit is considered to be completely assembled.

5.1.2 Future Specification Revisions: EPA reserves the right to change this specification should technological and/or market changes affect its usefulness to consumers, industry, or the environment. In keeping with current policy, revisions to the specification are arrived at through stakeholder discussions. In the event of a specification revision, please note that the ENERGY STAR certification is not automatically granted for the life of a product model.

6 CONSIDERATIONS FOR FUTURE REVISIONS

6.1.1 Communications Criteria: EPA will continue to monitor the market and consider use-cases for UPS connected capabilities, such as demand response, that can save energy or help balance grid loads. If a U.S. market for grid-connected demand response capable UPSs starts to develop, EPA may reconsider including optional connected functionality criteria.

Note: 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[11] and NUT Project[12]. While these capabilities can save energy, associated UPS software is capable, mature and widely available. Thus, inclusion of ENERGY STAR communication and reporting requirements is not likely to drive a significant market response.

EPA also 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[13], EPA identified only one instance, outside of North America, where UPSs were being tapped for load balancing[14]. In addition, one commenter opined that the DR potential for UPS is unproven, as noted in the Ecodesign Preparatory study on Smart Appliances (Lot 33)[15] This study concluded that due to how they are used (with stored capacity reserved for grid outages), UPS do not "allow a large amount of flexibility" for DR.

11 Spiceworks, "Check IT with UPS Monitoring Software", https://www.spiceworks.com/free-ups-power-management-software/, Accessed August 18, 2017.
12 Network UPS Tools (NUT), "Welcome", http://networkupstools.org/, Accessed August 18, 2017.
13 IEEE paper, presented in a 2012 conference in Chennai, India, "A smart Uninterruptible Power Supply based on frequency linked pricing mechanism" that describes a price-responsive UPS that charges when electricity pricing is favorable and uses battery stored energy when prices are high.
14 UK startup, upside energy UK, offers a cloud-service that aggregates energy from different products including PV/solar, EVs and UPS to help balance the grid.
15 VITO, Viegand & Maagøe, Armines and Bonn University, "Ecodesign Preparatory Study on Smart Appliances (Lott 33), January 19, 2017, p. 21. http://www.eco-smartappliances.eu/Documents/Ecodesign%20Preparatory%20Study%20on%20Smart%20Appliances%20_Tasks%201%20to%206.pdf

As noted in Draft 1, EPA remains interested in recognizing partners that effectively promote and facilitate the recycling of sealed lead-acid batteries, especially among consumers. While EPA will not include any requirements in this area, EPA would like to increase the number of products that include the recycling service details and will actively work with manufacturers to increase the percentage of products that have a URL associated with a take back program. EPA will also work to develop further materials for the ENERGY STAR website to highlight the importance of lead-acid battery recycling. Any stakeholders that would like to assist with this effort should notify ups@energystar.gov with their interest. Improving the recycling rates for lead-acid batteries used with UPSs can lead to significant environmental benefits.