



# ENERGY STAR<sup>®</sup> Program Requirements Product Specification for Displays

## Eligibility Criteria Draft 2 Version 7.0

1 Following is the ENERGY STAR product specification (“specification”) for Displays. A product shall meet  
2 all of the identified criteria if it is to earn the ENERGY STAR.

### 3 1 DEFINITIONS

#### 4 A) Product Types:

5 1) Electronic Display (Display): A product with a display screen and associated electronics,  
6 often encased in a single housing, that as its primary function produces visual information  
7 from (1) a computer, workstation, or server via one or more inputs (e.g., VGA, DVI, HDMI,  
8 DisplayPort, IEEE 1394, USB), (2) external storage (e.g., USB flash drive, memory card), or  
9 (3) a network connection.

10 a) Monitor: An electronic display intended for one person to view in a desk based  
11 environment.

12 b) Signage Display: An electronic display intended for multiple people to view in non-  
13 desk based environments, such as retail or department stores, restaurants,  
14 museums, hotels, outdoor venues, airports, conference rooms or classrooms. For the  
15 purposes of this specification, a display shall be classified as a signage display if it  
16 meets two or more criteria listed below:

17 (1) Diagonal screen size is greater than 30 inches;

18 (2) Maximum Reported Luminance is greater than 400 candelas per square meter;  
19 or

20 (3) Pixel density is less than or equal to 5,000 pixels per square inch.

21 **Note:** Following the publication of Draft 1, stakeholders commented that defining signage displays solely  
22 as displays with pixel density less than or equal to 5,000 pixels per square inch does not adequately  
23 capture all signage displays. In particular, there are smaller Ultra High Definition models that exceed the  
24 pixel density threshold. EPA realizes that the various characteristics (size, brightness, resolution) of  
25 monitors and signage displays sometimes overlap. Therefore, EPA is proposing a set of three criteria; a  
26 Display would have to meet at least two to be classified as a Signage Display.

27 EPA is also considering additional criteria, such as area greater than 10 dm<sup>2</sup> (155 square inches), ability  
28 to perform scaling for use in video walls, unique addressing, remote-control disabling, vertical and  
29 horizontal orientation, continuous use, and networking, to further distinguish Signage Displays from  
30 Computer Monitors.

31 Finally, EPA is also considering definitions based on application such as specifying that Signage Displays  
32 are “designed primarily to display information in public areas including, but not limited to, retail or  
33 department stores, restaurants, museums, conference and meeting centers, fairs, train or metro stations,  
34 airports, school campuses or healthcare organizations for simultaneous viewing by more users” EPA  
35 welcomes stakeholder feedback regarding product types and the applicability of the proposed criteria or  
36 any others.

#### 37 B) Operational Modes:

- 38 1) On Mode: The mode in which the display has been activated, and is providing the primary  
39 function.
- 40 2) Sleep Mode: A low-power mode in which the display provides one or more non-primary protective  
41 functions or continuous functions.
- 42 Note: Sleep Mode may serve the following functions: facilitate the activation of On Mode via  
43 remote switch, internal sensor, or timer; provide information or status displays including clocks;  
44 support sensor-based functions; or maintain a network presence.
- 45 3) Off Mode: The mode where the display is connected to a power source, produces no visual  
46 information, and cannot be switched into any other mode with the remote control unit, an internal  
47 signal, or an external signal.
- 48 Note: The display may only exit this mode by direct user actuation of an integrated power switch  
49 or control. Some products may not have an Off Mode.

50 **Note:** EPA is proposing slightly revised definitions above for On Mode, Sleep Mode, and Off Mode to  
51 clarify the types of functions and include notes where helpful. EPA welcomes stakeholder feedback as to  
52 whether these modes appropriately capture the operation of displays.

53 C) Visual Characteristics:

- 54 1) Ambient Light Conditions: The combination of light illuminances in the environment  
55 surrounding a display, such as a living room or an office.
- 56 2) Automatic Brightness Control (ABC): The self-acting mechanism that controls the brightness  
57 of a Display as a function of Ambient Light Conditions.
- 58 3) Color Gamut: Color gamut area shall be reported in the CIE 1976  $u'v'$  color space per  
59 Section 5.18 Gamut Area of the Information Display Measurements Standard Version 1.03.

**Note:** EPA received feedback that much of the color information in its dataset reflects the NTSC gamut designed for analog television where the color space is not consistently noted among models. The stakeholder suggested EPA define color gamut and require consistent reporting in terms of percentage of sRGB coverage in the CIE 1976 ( $u'v'$ ) color space which is more uniform than the CIE 1931 space, reflects the current practice in color science, and helps better differentiate model performance. As such, EPA proposes that color gamut shall be reported in the CIE 1976  $u'v'$  color space. To minimize ambiguity and harmonize with the latest industry standards, EPA has additionally referenced the Section 5.18 Gamut Area of the Information Display Measurements Standard Version 1.03 for guidance on measurement and reporting.

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- 61 4) Luminance: The photometric measure of the luminous intensity per unit area of light  
62 travelling in a given direction, expressed in candelas per square meter ( $cd/m^2$ ).
- 63 a) Maximum Reported Luminance: The maximum luminance the display may attain at  
64 an On Mode preset setting, and as specified by the manufacturer, for example, in the  
65 user manual.
- 66 b) Maximum Measured Luminance: The maximum measured luminance the display  
67 may attain by manually configuring its controls, such as brightness and contrast.
- 68 c) As-shipped Luminance: The luminance of the display at the factory default preset  
69 setting the manufacturer selects for normal home or applicable market use.
- 70 5) Native Vertical Resolution: The number of physical lines along the vertical axis of the  
71 Display within the visible area of the Display.

72 Note: A display with a screen resolution of 1920 x 1080 (horizontal x vertical) would have a  
73 Native Vertical Resolution of 1080).

74 6) Screen Area: The visible area of the display that produces images.

75 Note: Screen Area is calculated by multiplying the viewable image width by the viewable  
76 image height. For curved screens, measure the width and height along the arc of the  
77 display.

78 D) Additional Functions and Features:

79 1) Bridge Connection: A physical connection between two hub controllers (i.e., USB, FireWire).

80 Note: Bridge Connections allow for expansion of ports typically for the purpose of relocating  
81 the ports to a more convenient location or increasing the number of available ports.

82 2) Full Network Connectivity: The ability of the display to maintain network presence while in  
83 Sleep Mode. Presence of the display, its network services, and its applications, is  
84 maintained even if some components of the display are powered down. The display can  
85 elect to change power states based on receipt of network data from remote network devices,  
86 but should otherwise stay in Sleep Mode absent a demand for services from a remote  
87 network device.

88 Note: Full Network Connectivity is not limited to a specific set of protocols. Also referred to  
89 as “network proxy” functionality and described in the Ecma-393 standard.

90 3) Occupancy Sensor: A device used to detect human presence in front of or in the area  
91 surrounding a display.

92 Note: An Occupancy Sensor is typically used to switch a Display between On Mode and  
93 Sleep Mode.

94 4) Touch Technology: Enables the user to interact with a product by touching areas on the  
95 Display screen.

96 **Note:** Per stakeholder comment on Draft 1, EPA has added a revised the definition for Touch Technology  
97 to refer only to technology embedded on the displays screen to exclude any bezel or remote touch  
98 components.

99 5) Plug-in Module: A modular plugin device that provides one or more of the following functions  
100 without the explicit purpose of providing general computing function:

101 a) Display images, mirror remote content streamed to it, or otherwise render content on  
102 the screen from local or remote sources; or

103 b) Process touch signals.

104 Note: Modules providing additional input options are not considered Plug-in Modules for the  
105 purposes of this specification.

106 **Note:** EPA has revised the Draft 1 definition of “Internal Processor” to “Plug-in Module” to focus on add-  
107 on modularity and to account for plugin enhancements that might be present in signage displays or  
108 monitors for either rendering images or processing touch signals. This definition is intended to exclude  
109 any processing capability that might meet the threshold of a computer for general computing use, and  
110 thus would be considered a computer by the ENERGY STAR Program.

- 111 E) Product Family: A group of product models that are (1) made by the same manufacturer, (2)  
112 share the same Screen Area, Resolution, and Maximum Reported Luminance, and (3) of a  
113 common basic screen design. Models within a Product Family may differ from each other  
114 according to one or more characteristics or features. For displays, acceptable variations within a  
115 Product Family include:
- 116 1) External housing;
  - 117 2) Number and types of interfaces;
  - 118 3) Number and types of data, network, or peripheral ports; and
  - 119 4) Processing and memory capability.

120 **Note:** For clarification, EPA has modified the definition of Product Family slightly to refer to "External  
121 housing" to differentiate it from internal screen components.

- 122 F) Representative Model: The product configuration that is tested for ENERGY STAR certification  
123 and is intended to be marketed and labeled as ENERGY STAR.

124 G) Power Source

- 125 1) External Power Supply (EPS): An external power supply circuit that is used to convert  
126 household electric current into dc current or lower-voltage ac current to operate a consumer  
127 product.
- 128 2) Standard dc: A method for transmitting dc power defined by a well-known technology  
129 standard, enabling plug-and-play interoperability.

130 Note: Common examples are USB and Power-over-Ethernet. Usually Standard dc includes  
131 both power and communications over the same cable, but as with the  
132 380 V dc standard, that is not required.

## 133 2 SCOPE

### 134 2.1 Included Products

135 2.1.1 Products that meet the definition of a display as specified herein and are powered directly from ac  
136 mains, an External Power Supply, or Standard dc are eligible for ENERGY STAR certification,  
137 with the exception of products listed in Section 2.2. Typical products that would be eligible for  
138 certification under this specification include:

- 139 i. Monitors;
- 140 ii. Monitors with keyboard, video, and mouse (KVM) switch functionality;
- 141 iii. Signage Displays; and
- 142 iv. Signage Displays and Monitors with Plug-in Modules.

143 **Note:** EPA has clarified that products powered via an external power supply are included in the Version  
144 7.0 specification.

### 145 2.2 Excluded Products

146 2.2.1 Products that are covered under other ENERGY STAR product specifications are not eligible for  
147 certification under this specification including Televisions and Computers (Thin Clients,  
148 Slates/Tablets, Portable All-in-one Computers). The list of specifications currently in effect can be  
149 found at [www.energystar.gov/products](http://www.energystar.gov/products).

- 150 2.2.2 The following products are not eligible for certification under this specification:
- 151 i. Products with an integrated television tuner;
- 152 ii. Displays with integrated or replaceable batteries designed to support primary operation  
153 without ac mains or external dc power, or device mobility (e.g., electronic readers, battery-  
154 powered digital picture frames); and
- 155 iii. Products that must meet Food and Drug Administration specifications for medical devices  
156 that prohibit power management capabilities and/or do not have a power state meeting the  
157 definition of Sleep Mode.

158 **Note:** Stakeholders expressed support for the above scope exclusions proposed in Draft 1. Per a  
159 stakeholder suggestion, EPA has further specified the types of battery-powered devices excluded to  
160 encompass those that are intended for mobility such as personal computing or communication devices.

### 161 3 CERTIFICATION CRITERIA

#### 162 3.1 Significant Digits and Rounding

- 163 3.1.1 All calculations shall be carried out with directly measured (unrounded) values.
- 164 3.1.2 Unless otherwise specified, compliance with specification requirements shall be evaluated using  
165 directly measured or calculated values without any benefit from rounding.
- 166 3.1.3 Directly measured or calculated values that are submitted for reporting on the ENERGY STAR  
167 website shall be rounded to the nearest significant digit as expressed in the corresponding  
168 specification requirements.

169 **3.2 General Requirements for Monitors and Signage Displays**

170 3.2.1 External Power Supplies (EPSs): Single- and Multiple-voltage EPSs shall meet the Level VI or  
171 higher performance requirements under the International Efficiency Marking Protocol when tested  
172 according to the Uniform Test Method for Measuring the Energy Consumption of External Power  
173 Supplies, Appendix Z to 10 CFR Part 430.

174 i. Single- and Multiple-voltage EPSs shall include the Level VI or higher marking.

175 ii. Additional information on the Marking Protocol is available  
176 at <http://www.regulations.gov/#!documentDetail;D=EERE-2008-BT-STD-0005-0218>.

177 3.2.2 Power Management:

178 i. Products shall offer at least one power management feature that is enabled by default, and  
179 that can be used to automatically transition from On Mode to Sleep Mode either by a  
180 connected host device or internally (e.g., support for VESA Display Power Management  
181 Signaling (DPMS), enabled by default).

182 ii. Products that generate content for display from one or more internal sources shall have a  
183 sensor or timer enabled by default to automatically engage Sleep or Off Mode.

184 iii. For products that have an internal default delay time after which the product transitions  
185 from On Mode to Sleep Mode or Off Mode, the delay time shall be reported.

186 iv. Monitors shall automatically enter Sleep Mode or Off Mode within 5 minutes of being  
187 disconnected from a host computer.

188 **Note:** Following Draft 1, a stakeholder suggested a 5 minute Sleep Mode following disconnection. EPA  
189 agrees that the stakeholder's suggested requirement of a 5 minute power is unlikely to impact the user  
190 experience, and could save energy, so has included it above.

191 3.2.3 Signage displays shall have a true power factor in On Mode of 0.7 or greater per Part G of  
192 Section 5.2 in the ENERGY STAR Test Method.

193 **Note:** Signage displays typically have higher power levels than consumer monitors and commercial  
194 buildings where signage displays are installed have longer wiring runs than residential buildings.  
195 Therefore, EPA is proposing a 0.7 power factor requirement to ensure products address broader losses  
196 while improving efficiency. Data indicate that signage displays across all sizes and maximum luminance  
197 criteria are capable of meeting this power factor level. EPA welcomes stakeholder feedback on the impact  
198 of this proposed requirement.

199 **3.3 Energy Requirements for Computer Monitors**

200 3.3.1 The Total Energy Consumption (TEC) in kWh shall be calculated per Equation 1 based on  
201 measured values.

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### Equation 1: Total Energy Consumption Calculation

$$E_{TEC} = 8.76 \times (0.35 \times P_{ON} + 0.65 \times P_{SLEEP})$$

Where:

- $E_{TEC}$  is the Total Energy Consumption calculation in kWh;
- $P_{ON}$  is Measured On Mode Power in watts; and
- $P_{SLEEP}$  is Measured Sleep Mode Power in watts.

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**Note:** In Draft 2, EPA is proposing to employ the Total Energy Consumption (TEC) approach introduced in Draft 1 for monitors. Since EPA only has data on the duty cycle for monitors, further below, EPA proposes maintaining a modal approach for signage displays. The TEC approach proposed for monitors has been successfully used in the ENERGY STAR Computers, Set-top Box, and Imaging specifications, where it has led to a variety of benefits without losing efficiency gains in low-power modes. In particular, a TEC approach provides more flexibility for manufacturers to take different design approaches to saving energy overall, rather than focusing only on single modes. As such, a TEC approach focuses on the total energy and cost savings, rather than on specific components.

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Commenters generally supported the use of a TEC approach for monitors as outlined in Draft 1. Some stakeholders, however, expressed concern that a TEC approach could potentially disincentivize future efficiency gains in low power modes. EPA is sensitive to this point; however, past experience in other ENERGY STAR product categories suggests that for products with expanding functionalities, a TEC approach ultimately allows for more stringent requirements than a modal approach in combination with adders. Under a modal limit, as products become more fully featured, the likelihood becomes greater that multiple requirements must each be made less stringent to account for the interactions between features. A TEC approach maintains stringency in limits on power consumption, but the amount of Sleep Mode allowances become less critical to the overall energy performance of the product. Under a TEC approach, additional efficiency improvements would be needed in On Mode to counter any potential increases in energy consumption in Sleep Mode. Thus, EPA believes it can set lower TEC levels than would be possible with a modal approach in combination with adders for energy using features.

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3.3.2 The Maximum TEC ( $E_{TEC\_MAX}$ ) in kWh for Monitors shall be calculated per Equation 2.

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### Equation 2: Calculation of Monitor Maximum TEC ( $E_{TEC\_MAX}$ ) in kWh

$$E_{TEC\_MAX} = 6.13 \times r + 91 \times \tanh(0.0016 \times [A - 59] + 0.085) + 9$$

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Where:

- $r$  = Screen resolution in megapixels;
- $A$  = Viewable screen area in  $in^2$ ; and
- The result shall be rounded to the nearest tenth of a kWh for reporting.

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**Note:** EPA received mixed feedback in response to the On Mode power requirements in Draft 1. Some stakeholders supported EPA’s proposal and advocated that the requirements be made more stringent, whereas others expressed concern that the requirements were too stringent. In this draft, EPA has retained an efficiency requirement that is more challenging for larger screens, as proposed in Draft 1. This approach continues to allow for a good selection of products across all sizes, including those in the larger sizes, from 35 brands. Since the release of Draft 1, EPA updated its dataset with the latest models for a total of 1051 (up from 962 models). As such, EPA proposes slightly revised On Mode power levels—expressed in a TEC approach—that recognize the current top performing 21 percent of products in the market. EPA seeks to ensure that ENERGY STAR remains a market differentiator for efficiency in monitors when the specification takes effect in 2016.

247 Under the Draft 2 proposal models across all sizes and performance features (resolution, color gamut,  
 248 and viewing angle) would be eligible to earn the ENERGY STAR. Despite the lower pass rate of 13  
 249 percent in monitors with diagonal screen sizes 19 to 22 inches, EPA notes that many models are very  
 250 close to the proposed levels only incremental improvements in efficiency are needed to meet the  
 251 proposed criteria. Of note, in assessing its dataset, EPA excluded dc-powered products when developing  
 252 the requirement since they were not tested with the Version 7.0 direct dc measurement procedures.

253 EPA has maintained the Draft 1 allocation of 2.0 W in On Mode per Megapixel of Total Native Resolution  
 254 and translated it into the proposed Total Energy Consumption requirements. The 2.0 W allocation  
 255 sufficiently captures models across a wide range of resolutions up to 4k/Ultra High Definition.

256 3.3.3 For all Monitors, Calculated TEC ( $E_{TEC}$ ) in kWh shall be less than or equal to the calculation of  
 257 Maximum TEC ( $E_{TEC\_MAX}$ ) with the applicable allowances and adjustments (applied at most once)  
 258 per Equation 3.

259 **Equation 3: Total Energy Consumption Requirement for Monitors**

$$E_{TEC} \leq (E_{TEC\_MAX} + E_{EP} + E_{ABC} + E_N + + E_{OS}) \times eff_{AC\_DC}$$

260 Where:

- 261 ■  $E_{TEC}$  is TEC in kWh calculated per Equation 1;
- 262 ■  $E_{TEC\_MAX}$  is the Maximum TEC requirement in kWh calculated per Equation 2;
- 263 ■  $E_{EP}$  is the enhanced performance display allowance in kWh per Table 2;
- 264 ■  $E_{ABC}$  is the Automatic Brightness Control allowance in kWh per Equation 5;
- 265 ■  $E_N$  is the Full Network Connectivity allowance in kWh per Table 3;
- 266 ■  $E_{OS}$  is the Occupancy Sensor allowance in kWh per Table 4; and
- 267 ■  $eff_{AC\_DC}$  is the standard adjustment for ac-dc power conversion losses that occur at the device  
 268 powering the Display, and is 1.0 for Ac-powered Displays and 0.85 for displays with Standard dc; and  
 269 The result shall be rounded to the nearest tenth of a kWh for reporting.  
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271 3.3.4 For Monitors contrast ratio of at least 60:1 measured at a horizontal viewing angle of at least 85°  
 272 from the perpendicular, with or without a screen cover glass and a native resolution greater than  
 273 or equal to 2.3 megapixels (MP), shall add only one of the following Table 1 allowances to  
 274 Equation 2 if the minimum Color Gamut criteria are met:

275 **Table 1: Calculation of Energy Allowance for Enhanced Performance Displays**

Color Gamut Criteria	<b><math>E_{EP}</math> (kWh)</b> Where $E_{TEC\_MAX}$ is the Maximum TEC requirement in kWh.
Color Gamut is sRGB or greater as defined by IEC 61966-2-1. Alternate color spaces are allowable as long as 99% or more of defined sRGB colors are supported.	$0.25 \times E_{TEC\_MAX}$
Color Gamut is 96% or greater of Adobe® RGB Version 2005-05.	$0.65 \times E_{TEC\_MAX}$

277 **Note:** In Draft 1, EPA requested feedback on whether the characteristics currently describing Enhanced  
 278 Performance Displays (EPDs) in Version 6.0 were still relevant. EPA did not receive any feedback to the  
 279 contrary and therefore proposes to retain the description of enhanced performance displays in Section  
 280 3.3.4. In Draft 1, EPA also added a clarification that color space shall be considered, such that “alternate  
 281 color spaces are allowable as long as 99 percent or more of defined sRGB colors are supported.”



282 Based on stakeholder feedback, for Draft 2 EPA further classified models based on color gamut  
283 performance using the Version 6.0 dataset. Although data were submitted using varying standards  
284 (NTSC, sRGB, Adobe RGB), EPA normalized the data to make it comparable by converting the  
285 percentage of the color space of each standard into percentage of the color space of the CIE standard.  
286 EPA welcomes stakeholder feedback on the accuracy of this approach.

287 In further reviewing color gamut data, EPA found that nearly half of all monitors in the dataset cover the  
288 sRGB color gamut, indicating that this level of performance is no longer limited to a small subset of  
289 premium models. Holding resolution and area constant, the data indicate that increased color gamut  
290 performance typically requires more power. Models supporting 99 percent or more defined sRGB colors  
291 indicate a need for additional power over models with a smaller color space. Models covering at least 96  
292 percent of Adobe RGB-- an even greater coverage in color space—appear to require more power than  
293 those where 99 percent or more of defined sRGB colors are supported. EPA is therefore proposing a  
294 tiered allowance approach for Enhanced Performance Displays based on criteria for color gamut as  
295 follows:

296 - 30 percent allowance for models meeting current EPD criteria with color gamut greater than 99 percent  
297 of sRGB.

298 - 65 percent allowance for models meeting the current EPD criteria with color gamut greater than 99  
299 percent of sRGB and at least 96 percent Adobe RGB.

300 Of models that already meet the EPD requirements for contrast ratio and resolution, under EPA's  
301 proposed approach for EPD allowances based on color gamut, 12 models from four manufacturers out of  
302 the 40 models in EPA's dataset of enhanced performance displays would continue to qualify. With a 30  
303 percent allowance for EPDs with at least 99 percent sRGB, 28 percent of EPA's dataset of EPDs would  
304 continue to qualify. With the additional 65 percent allowance for models with at least 96 percent Adobe  
305 RGB, 3 out of 10 models, or 30 percent in the Adobe RGB category, would meet the proposed criteria.  
306 EPA considers that its EPD dataset is reflective of the market given the diversity of intended high-end  
307 uses (entertainment, printing-business models), sizes, and high resolution models.

308 Since color performance is a continuous variable (for example, some models are 94 percent Adobe RGB,  
309 101 percent sRGB, 102 percent sRGB) rather than a discrete binary category (Adobe RGB vs. sRGB)  
310 EPA seeks feedback on the appropriateness of the binning proposed here. EPA requests additional  
311 stakeholder feedback and data regarding how viewing angle and color and brightness uniformity might  
312 affect power consumption. In particular, EPA is interested in understanding the predominant industry-  
313 accepted standard measurements for viewing angle and uniformity, and how these distinguish premium  
314 from entry-level models.

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316 3.3.5 For monitors with Automatic Brightness Control (ABC) enabled by default, an energy allowance  
317 ( $E_{ABC}$ ), as calculated per Equation 5, shall be added to  $E_{TEC\_MAX}$ , as calculated per Equation 2, if  
318 the On Mode power reduction ( $R_{ABC}$ ), as calculated per Equation 4, is greater than or equal to  
319 20%.

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**Equation 4: Calculation of On Mode Reduction with ABC Enabled by Default**

$$R_{ABC} = 100 \times \left( \frac{P_{300} - P_{12}}{P_{300}} \right)$$

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Where:

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▪  $R_{ABC}$  is the On Mode percent power reduction due to ABC;

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▪  $P_{300}$  is the On Mode power in watts, as measured at an ambient light level of 300 lux in Section 6.4 of the Test Method; and

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▪  $P_{12}$  is the On Mode power in watts, as measured at an ambient light level of 12 lux in Section 6.4 of the Test Method.

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**Equation 5: Monitors ABC Energy Allowance ( $E_{ABC}$ ) for Monitors**

$$E_{ABC} = 0.05 \times E_{TEC\_MAX}$$

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Where:

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▪  $E_{ABC}$  is the energy allowance for Automatic Brightness Control in kWh; and

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▪  $E_{TEC\_MAX}$  is the Maximum TEC in kWh, per Equation 2.

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**Note:** EPA is proposing an incentive for ABC to promote its wider adoption in Displays, as the technology has proven successful in reducing energy (and thereby extending battery life) in notebook computers, to such an extent that it is ubiquitous. However, as the technology is still infrequent among Displays, EPA seeks more data on settings where Displays will be used, in particular office and outdoor lighting conditions, as well as how to identify and incentivize ABC usability to ensure real-world savings.

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3.3.6 Products with Full Network Connectivity confirmed in Section 6.7 of the ENERGY STAR Test Method shall apply the allowance specified in Table 2.

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**Table 2: Full Network Connectivity Energy Allowance ( $E_N$ ) for Monitors**

$E_N$ (kWh)
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3.3.7 Products tested with an Occupancy Sensor active shall apply the allowance specified in Table 3.

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**Table 3: Additional Functions Energy Allowance ( $E_{OS}$ ) for Monitors**

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Type	Allowance (kWh)
Occupancy Sensor $E_{OS}$	1.7

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**Note:** The proposed Full Network Connectivity and Additional Allowances are consistent with Draft 1, but have been converted to an annual kilowatt-hour allowance. With Draft 2, EPA is no longer proposing an allowance for touch functionality due to a lack of clarity on whether monitors with touch technology were tested with it enabled, resulting in insufficient data on which to base an allowance. EPA welcomes stakeholder clarification on whether existing test data in EPA's dataset accounts for touch functionality enabled by default and any additional data referencing power consumption related to touch functionality.

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351 **3.4 On Mode Requirements for Signage Displays**

352 3.4.1 The Maximum On Mode Power ( $P_{ON\_MAX}$ ) in watts shall be calculated per Equation 6.

353 **Equation 6: Calculation of Maximum On Mode Power ( $P_{ON\_MAX}$ ) in Watts for Signage Displays**

$$P_{ON\_MAX} = (7.5 \times 10^{-5} \times \ell \times A) + 82 \times \tanh(0.001 \times (A - 200.0) + 0.1) + 6.0$$

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Where:

- $A$  = Screen Area in square inches; and
- $\ell$  = Maximum Measured Luminance of the display in candelas per square meter, as measured in Section 6.2 of the test method.

359 **Note:** Absent additional data, EPA proposes to retain the luminance allowance (or a capacity measure for  
360 luminance) from Draft 1 to account for brighter displays needing additional power. The proposed  
361 luminance allowance accounts for a correlation between energy consumption and increased screen  
362 brightness that scales with size, given that many signage displays are significantly brighter than monitors  
363 or products intended solely for indoor use. EPA has also added a  $0.0254^2$  correction to account for  
364 luminance expressed in  $\text{cd}/\text{m}^2$  and area in  $\text{in}^2$  rather than expressing the equation in megacandelas, per  
365 the equation in Draft 1. The resultant allowance of 0.116 per total candela is shown in Equation 6.

366 In Draft 2, EPA has also corrected an error in the equation for Maximum On Mode Power for Signage  
367 Displays such that the requirement now accurately reflects the performance of the top 25 percent of  
368 signage products in EPA's dataset, as was intended in Draft 1. One stakeholder expressed concerned  
369 that an allowance based on as-shipped luminance would incentivize manufacturers to ship displays  
370 brighter. EPA notes that the luminance allowance is based on the Maximum Measured Luminance and  
371 therefore will not affect the As-shipped Luminance value.

372 3.4.2 Measured On Mode Power ( $P_{ON}$ ) in watts shall be less than or equal the calculation of Maximum  
373 On Mode Power ( $P_{ON\_MAX}$ ) with the applicable allowances and adjustments per Equation 7.

374 **Equation 7: On Mode Power Requirement for Signage Displays**

$$P_{ON} \leq P_{ON\_MAX} + P_{ABC}$$

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Where:

- $P_{ON}$  is On Mode Power in watts, as measured in Section 6.3 or 6.4 of the Test Method;
- $P_{ON\_MAX}$  is the Maximum On Mode Power in watts, per Equation 7;
- $P_{ABC}$  is the On Mode power allowance for ABC in watts, per Equation 8; and
- The result shall be rounded to the nearest tenth of a watt for reporting.

381 3.4.3 For Signage Displays with ABC enabled by default, a power allowance ( $P_{ABC}$ ), as calculated per  
382 Equation 8, shall be added to  $P_{ON\_MAX}$ , as calculated per Equation 7, if the On Mode power  
383 reduction ( $R_{ABC}$ ), as calculated per Equation 4, is greater than or equal to 20 percent.

384 **Equation 8: Calculation of On Mode Power Allowance for Signage Displays with ABC Enabled by**  
385 **Default**

$$P_{ABC} = 0.05 \times P_{ON\_MAX}$$

386  
387  
388

Where:

- $P_{ABC}$  is the Measured On Mode Power allowance for ABC in watts; and
- $P_{ON\_MAX}$  is the Maximum On Mode Power requirement in watts.

389 **Note:** EPA anticipates savings opportunities resulting from the implementation of Automatic Brightness  
390 Control (ABC) and has proposed an allowance of 5 percent, consistent with its allowance for monitors.  
391 EPA seeks to drive implementation of ABC as a way to deliver additional savings, especially among  
392 products that will be used in variable ambient light conditions. EPA welcomes any data on the savings  
393 opportunity and feedback on the proposed ABC allowance.

394

395 **3.5 Sleep Mode Requirements for Signage Displays**

396 3.5.1 Measured Sleep Mode Power ( $P_{SLEEP}$ ) in watts shall be less than or equal the calculation of  
397 Maximum Sleep Mode Power Requirement ( $P_{ON\_MAX}$ ) with the applicable allowances and  
398 adjustments (applied at most once) per Equation 9.

399 **Equation 9: Sleep Mode Power Requirement for Signage Displays**

$$P_{SLEEP} \leq P_{SLEEP\_MAX} + P_N + P_{OS}$$

400

401

Where:

402

- $P_{SLEEP}$  is Measured Sleep Mode Power in watts;
- $P_{SLEEP\_MAX}$  is the Maximum Sleep Mode Power requirement in watts per Table 4;
- $P_N$  is the Full Network Connectivity allowance in watts per Table 5;
- $P_{OS}$  is the Occupancy Sensor allowance in watts per Table 6; and
- The result shall be rounded to the nearest tenth of a watt for reporting.

403

404

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408 **Table 4: Maximum Sleep Mode Power Requirement ( $P_{SLEEP\_MAX}$ ) for Signage Displays**

$P_{SLEEP\_MAX}$ (watts)
0.5

409

410 3.5.2 Products with Full Network Connectivity confirmed in Section 6.7 of the ENERGY STAR Test  
411 Method shall apply the allowance specified in Table 5.

412 **Table 5: Full Network Connectivity Allowance for Signage Displays**

$P_N$ (watts)
0.5

413

414 3.5.3 Products tested with an Occupancy Sensor active shall apply the allowances specified in Table 6.

415 **Table 6: Additional Functions Sleep Mode Power Allowance for Signage Displays**

Type	Allowance (watts)
Occupancy Sensor $P_{OS}$	0.3

416

417 **Note:** EPA is no longer proposing an allowance for touch functionality due to a lack of clarity whether  
418 monitors with touch technology were tested with it enabled, resulting in insufficient data on which to base  
419 an allowance. EPA welcomes stakeholder clarification on whether existing test data in EPA’s dataset  
420 accounts for touch functionality enabled by default and any additional data referencing power  
421 consumption related to touch functionality

422 **3.6 Off Mode Requirements for all Displays**

423 3.6.1 A product need not have an Off Mode to be eligible for certification. For products that do offer Off  
424 Mode, measured Off Mode power ( $P_{OFF}$ ) shall be less than or equal to the Maximum Off Mode  
425 Power Requirement ( $P_{OFF\_MAX}$ ) in Table 7.

426 **Table 7: Maximum Off Mode Power Requirement ( $P_{OFF\_MAX}$ )**

$P_{OFF\_MAX}$ (watts)
0.5

427 **3.7 Luminance Reporting Requirements**

428 3.7.1 Maximum Reported and Maximum Measured Luminance shall be reported for all products; As-  
429 Shipped Luminance shall be reported for all products except those with ABC enabled by default.

430  
431 Note: Products intended for sale in the US market are subject to minimum toxicity and recyclability  
432 requirements. Please see ENERGY STAR® Program Requirements for Displays: Partner Commitments  
433 for details.

434 **4 TEST REQUIREMENTS**

435 **4.1 Test Methods**

436 4.1.1 Test methods identified in Table 8 shall be used to determine certification for ENERGY STAR.

437 **Table 8: Test Methods for ENERGY STAR Certification**

Product Type	Test Method
All Product Types and Screen Sizes	Draft 2 ENERGY STAR Test Method for Determining Display Energy – Rev. Oct-2014
Enhanced Performance Monitors	International Committee for Display Metrology (ICDM) Information Display Measurements Standard – Version 1.03

438 **4.2 Number of Units Required for Testing**

439 4.2.1 One unit of a Representative Model, as defined in Section 1, shall be selected for testing.

440 4.2.2 For certification of a Product Family, the product configuration that represents the worst-case  
441 power consumption for each product category within the Product Family shall be considered the  
442 Representative Model.

443 **4.3 International Market Qualification**

444 4.3.1 Products shall be tested for qualification at the relevant input voltage/frequency combination for  
445 each market in which they will be sold and promoted as ENERGY STAR.

446 **5 USER INTERFACE**

447 5.1.1 Manufacturers are encouraged to design products in accordance with the user interface standard,  
448 IEEE P1621: Standard for User Interface Elements in Power Control of Electronic Devices  
449 Employed in Office/Consumer Environments. For details, see <http://energy.lbl.gov/controls/>.

450 **Note:** EPA is reviewing the above User Interface requirements under this specification revision.  
451 In order to better track these data, EPA is proposing that EPA-recognized certification bodies  
452 report to EPA whether or not products they certify comply with the standard. The reporting  
453 requirement would be in the form of a “Yes/No.” EPA welcomes feedback both this proposed  
454 requirement and whether the majority of products today comply with the standard.

455

## 456 6 EFFECTIVE DATE

457 6.1.1 Effective Date: The Version 6.0 ENERGY STAR Display specification shall take effect on **April**  
458 **15, 2016**. To qualify for ENERGY STAR, a product model shall meet the ENERGY STAR  
459 specification in effect on its date of manufacture. The date of manufacture is specific to each unit  
460 and is the date (e.g., month and year) on which a unit is considered to be completely assembled.

**Note:** EPA intends to finalize Version 7.0 in early summer 2015, where the specification would take effect in spring 2016.

461 6.1.2 Future Specification Revisions: EPA reserves the right to change this specification should  
462 technological and/or market changes affect its usefulness to consumers, industry, or the  
463 environment. In keeping with current policy, revisions to the specification are arrived at through  
464 stakeholder discussions. In the event of a specification revision, please note ENERGY STAR  
465 certification is not automatically granted for the life of a model

## 466 7 CONSIDERATIONS FOR FUTURE REVISIONS

467 7.1.1 On Mode DC Power Limit: EPA is interested in considering a separate On Mode Power  
468 Maximum requirement for Standard dc products that does not necessitate an ac-dc conversion  
469 calculation. EPA anticipates these products will become more popular on the market with the  
470 latest USB standard and looks forward to receiving additional direct dc-tested data for these  
471 products.

472  
473 7.1.2 Proxzzzying: EPA is interested in the extent to which display products with network connectivity  
474 and not already connected to a host device could employ proxzzzying to enter low power states  
475 and garner additional energy savings. EPA will continue to monitor the market to determine the  
476 applicability of incentivizing the use of proxzzzying in display products in future revisions to the  
477 specification.

478