ENERGY STAR® Program Requirements for Televisions

Eligibility Criteria
Draft 1 Version 9.0

Following is the Version 9.0 ENERGY STAR Product Specification for Televisions. A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

1 DEFINITIONS[1]

A) Product Types:

1) Television (TV)[2]: A product designed to produce dynamic video, contains an internal TV tuner encased within the product housing, and that is capable of receiving dynamic visual content from wired or wireless sources including but not limited to:

   a) Broadcast and similar services for terrestrial, cable, satellite, and/or broadband transmission of analog and/or digital signals; and/or

   b) Display-specific data connections, such as HDMI, Component video, S-video, Composite video; and/or

   c) Media storage devices such as a USB flash drive, a memory card, or a DVD; and/or

   d) Network connections, usually using Internet Protocol, typically carried over Ethernet or Wi-Fi.

2) Home Theater Display (HTD): A product with diagonal viewable screen size greater than 25 inches, that is designed to produce dynamic video, that does not contain an internal TV tuner encased within the product housing, that is primarily marketed for use in home theater applications, and that is capable of receiving dynamic visual content from wired or wireless sources including but not limited to:

   a) Display-specific data connections, such as HDMI, Component video, S-video, Composite video; and/or

   b) Media storage devices such as a USB flash drive, a memory card, or a DVD; and/or

   c) Network connections, usually using Internet Protocol, typically carried over Ethernet or Wi-Fi.

   Home Theater Display does not include Computer Monitors or Signage Displays (defined in the ENERGY STAR Product Specification for Displays).

3) Hospitality Television/Home Theater Display: A TV or HTD product which includes the following features:

   a) A control port for bi-directional communication (DB-9, RJ11, RJ12, RJ45, coaxial cable, or HDMI-CEC); and

1 Where applicable, these definitions are based on definitions in 10 CFR 430. When in conflict, the definitions in the Federal Test Procedure in 10 CFR 430 take precedence, including any future updates to the test procedure.
2 10 CFR 430.2

b) Activated hospitality protocol software (e.g., SmartPort, Meeting Professionals International (MPI), Multiple Television Interface (MTI), Serial Protocol) to provide direct access to Video-On-Demand (VOD) systems, non-video hotel services or a digital media player designed for hospitality-specific applications.

4) Projector: A product that is a mains-powered, optical device, for processing analog or digital video image information, in any, broadcasting, storage or networking format to modulate a light source and project the resulting image onto an external screen[3].

B) Operational Modes:

1) On Mode[4]: The mode of operation in which the TV/HTD is connected to mains power and is capable of producing dynamic video.

2) Standby-Passive Mode[5]: The mode of operation in which the TV/HTD is connected to mains power, produces neither sound nor picture, and can be switched into another mode with only the remote control unit or an internal signal.

3) Standby-Active, Low Mode[6]: The mode of operation in which the TV/HTD is connected to mains power, produces neither sound nor picture, can be switched into another mode with the remote control unit or an internal signal, and can additionally be switched into another mode with an external signal.

4) Standby-Active, High Mode[7]: The mode of operation in which the TV/HTD is connected to mains power, produces neither sound nor picture, is exchanging/receiving data with/from an external source, and can be switched into another mode with the remote control unit, an internal signal, or an external signal.

a) Download Acquisition Mode: The power mode in which the product is connected to a mains power source, produces neither sound nor picture, and is actively downloading data. Data downloads may include channel listing information for use by an Electronic Program Guide, TV/HTD setup data, channel map updates, firmware updates, monitoring for emergency messaging/communications or other network communications.

5) Off Mode[8]: The mode of operation in which the TV/HTD is connected to mains power, produces neither sound nor picture, and cannot be switched into any other mode of operation with the remote control unit, an internal signal, or external signal.

C) Additional Functions[9]: Functions that are not required for the basic operation of the device.

Note: Additional functions include, but are not limited to, a VCR unit, a DVD unit, an HDD unit, a FM-radio unit, a memory card-reader unit, or an ambient lighting unit.

1) Thin Client Capability: The ability of the TV/HTD to receive, decrypt, and display encrypted content provided by a Multichannel Video Programming Distributor (MVPD) over the Local Area Network via a server device co-located on the customer premises without the need for a client device at the TV/HTD.

3 AEA, Building on the Eco-design Directive, EuP Group Analysis: ENTR Lot 3 Sound and Imaging Equipment Task 1-7 Report, http://ec.europa.eu/DocsRoom/documents/10198/attachments/1/translations/en/renditions/pdf.
4 10 CFR 430, Subpart B, Appendix H, Section 2.14
5 10 CFR 430, Subpart B, Appendix H, Section 2.18
6 10 CFR 430, Subpart B, Appendix H, Section 2.20
7 10 CFR 430, Subpart B, Appendix H, Section 2.19,
8 10 CFR 430, Subpart B, Appendix H, Section 2.13
9 10 CFR 430, Subpart B, Appendix H, Section 2.1, which references International Electrotechnical Commission (IEC) Standard 62087 Ed. 3.

2) Full Network Connectivity: The ability of the TV/HTD to maintain network presence while in Standby-Active, Low mode. Presence of the TV/HTD, its network services, and its applications, is maintained even if some components of the TV/HTD are powered down. The TV/HTD can elect to change power states based on receipt of network data from remote network devices, but should otherwise stay in Standby-Active, Low mode absent a demand for services from a remote network device. Full network connectivity is not limited to a specific set of protocols. Also referred to as "network proxy" functionality and described in the Ecma-393 standard.

D) Special Functions[10]: Functions that are related to, but not required for, the basic operation of the device.

Note: Special functions include, but are not limited to, special sound processing, power saving functions (e.g., Automatic Brightness Control).

1) Automatic Brightness Control (ABC): The self-acting mechanism that controls the brightness of a display as a function of ambient light.

2) Gesture Recognition: Ability to recognize non-verbal communication through a movement of the body, head, or limbs to express or emphasize an idea, sentiment, or command.

3) Voice Recognition: Ability to recognize spoken words or phrases and to convert said communication into text or commands to which meaning has been assigned.

4) High Dynamic Range (HDR) Upscaling: A user-selectable Special Function that extends the luminance of the brightest scene elements and apparent saturation of colors of standard-dynamic range content in a manner similar to those provided by HDR10 or Dolby Vision encoding.

5) Motion-based Dynamic Dimming (MDD): A feature that adjusts luminance in response to the amount of motion in the displayed image.

Note: The definition for HDR Upscaling was moved to the Special Functions section as it is most commonly referred to as a special feature, rather than a TV setting.

The definition of MDD has been added as it is referenced in the specification.

E) TV/HTD Settings and Menus:

1) Preset Picture Setting[11](PPS): A preprogrammed factory setting obtained from the TV/HTD menu with pre-determined picture parameters such as brightness, contrast, color, sharpness, etc. Preset Picture Settings can be selected within the Home or Retail Configurations.

2) Default SDR Preset Picture Setting: The as-shipped SDR Preset Picture Setting that the TV/HTD enters immediately after making a selection from the Forced Menu. If the TV/HTD does not have a Forced Menu, this is the as-shipped SDR Preset Picture Setting. As referenced in this specification, default settings must be determined through direct observation of the as-shipped configuration.

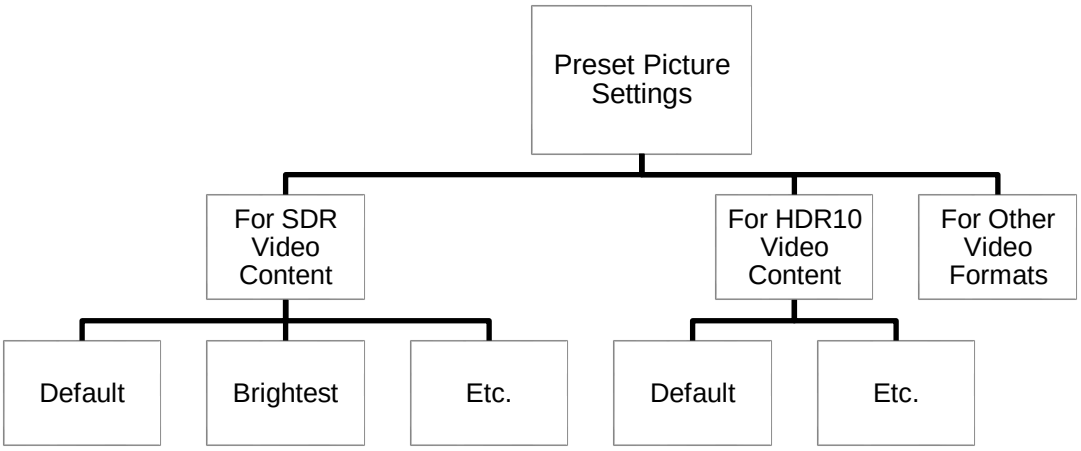
3) Brightest SDR Preset Picture Setting: The SDR Preset Picture Setting within the Home Configuration in which the TV/HTD produces the highest screen luminance.

4) Default HDR10 Preset Picture Setting: The as-shipped Preset Picture Setting when playing HDR10 content.

10 10 CFR 430, Subpart B, Appendix H, Section 2.17, which references IEC 62087 Ed. 3.
11 10 CFR 430, Subpart B, Appendix H, Section 2.15, with the exception of "Home or Retail Configurations"; Section 2.15 uses "home or retail mode" instead.

Note: For consistency during testing, EPA has refined definitions for the Default and Brightest PPSs and developed a definition for the Default HDR10 PPS. All three PPSs will be tested with the testing procedures specified in Section 4.4: Default SDR, Brightest SDR, and Default HDR10.

Figure 1: The Classification of Picture Setting Selection Options for TV/HTDs



Note: Figure 1 presents the hierarchy of PPSs to clarify how the settings are chosen by the user, be it though the Forced Menu upon initial configuration or the general settings menu. The choice of PPS is a function of the video format being played.

5) Home Configuration[12]: The TV/HTD configuration selected from the Forced Menu which is designed for typical consumer viewing and is recommended by the manufacturer for home environments.

6) Retail Configuration[13]: The TV/HTD configuration selected from the Forced Menu which is designed to highlight the TV/HTD's features in a retail environment. This configuration may display demos, disable configurable settings, or increase screen brightness in a manner which is not desirable for typical consumer viewing.

7) Forced Menu: A series of menus which require the selection of initial settings before allowing the user to utilize primary functions. Within these menus, an option is often presented to allow a choice between setting-up the TV/HTD for use in either the Retail or Home Configurations.

Note: The Forced Menu definition has been amended to highlight that it is the process by which a TV/HTD is initially setup by the user and may or may not offer a choice for Retail configuration.

The definition for Electronic Program Guide (EPG) has been deleted as it is not referenced throughout the specification.

F) Power Devices:

1) External Power Supply (EPS)[14]: Also referred to as External Power Adapter. An external power supply circuit that is used to convert household electric current into dc current or lower-voltage ac current to operate a consumer product.

12 10 CFR 430, Subpart B, Appendix H, Section 2.6
13 10 CFR 430, Subpart B, Appendix H, Section 2.16
14 10 CFR 430.2

2) Main Battery[15]: A battery capable of powering the TV/HTD to produce dynamic video without the support of mains power.

G) Product Characteristics:

1) Luminance[16]: The photometric measure of the luminous intensity per unit area of light traveling in a given direction, expressed in units of candelas per square meter (cd/m^2).

2) Dynamic Luminance: The luminance averaged across the entire screen area as measured during dynamic video play (measured per Section 4.4.14).

Note: The definition of Dynamic Luminance has been added as it is a metric measured through the testing in Section 4.4.

3) Screen Area: The viewable screen area of the product, calculated by multiplying the viewable image width by the viewable image height. For curved screens, the measurements shall be made along the curvature on the face of the screen rather than along a straight line/chord.

4) Native Vertical Resolution**:** The number of visible physical lines along the vertical axis of the TV/HTD (e.g., a TV/HTD with a screen resolution of 1920 x 1080 (horizontal x vertical) would have a Native Vertical Resolution of 1080).

5) Horizontal Resolution: The number of visible physical lines along the horizontal axis of the TV/HTD (e.g., a TV/HTD with a screen resolution of 1920 x 1080 (horizontal x vertical) would have a Horizontal Resolution of 1920).

6) Contrast Ratio: The contrast ratio is the ratio between the luminance of the brightest white and the darkest black that a TV can produce, as measured by the method defined in Section 4.55 below.

7) HD Display: A display with a resolution of 1920x1080 pixels.

8) 4K Display: A display with a resolution of 3840x2160 pixels.

9) 8K Display: A display with a resolution of 7680x4320 pixels.

Note: EPA has incorporated the definitions for Horizontal Resolution, Contrast Ratio, HD Display, 4K Display, and 8K Display as all are referenced to determine the applicable Adjustment Factors for use in the On Mode Power equations in Section 3.3.

H) Basic Model[17]: All units of a given type of product (or class thereof) manufactured by one manufacturer, having the same primary energy source, and which have essentially identical electrical, physical, and functional characteristics that affect energy consumption and energy efficiency.

I) Multichannel Video Programming Distributor (MVPD)[18]: A person such as, but not limited to, a cable operator, a multichannel multipoint distribution service, a direct broadcast satellite service, or a television receive-only satellite program distributor, who makes available for purchase, by subscribers or customers, multiple channels of video programming.

J) Unit Under Test (UUT): The unit currently undergoing testing.

15 10 CFR 430, Subpart B, Appendix H, Section 2.12
16 10 CFR 430, Subpart B, Appendix H, Section 2.11
17 10 CFR 430.2, with references to water consumption and other specific covered products removed.
18 As defined in 47 USC § 522(13)

2 SCOPE

2.1 Included Products

2.1.1 Products that are: (1) marketed to the consumer as a TV/HTD (i.e., TV/HTD is the primary function); (2) capable of being powered from a wall outlet or with an external power supply; and (3) meet one of the following product type definitions, are eligible for ENERGY STAR certification, with the exception of products listed in Section 2.2:

i. TVs
ii. Hospitality TV/HTDs
iii. Home Theater Displays

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/specifications.

2.2.2 Products that satisfy one or more of the following conditions are not eligible for ENERGY STAR certification under this specification:

i. Projectors.
ii. TV/HTDs with a Main Battery that enables operation without connected mains power.
iii. Products with a computer input port (e.g., VGA), that are marketed and sold primarily as computer monitors or other displays, and that do not contain an integrated TV tuner encased within the product housing.

3 CERTIFICATION CRITERIA

3.1 Significant Digits and Rounding

3.1.1 All calculations shall be carried out with directly 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 Annual Energy Consumption (AEC) values less than 100 kWh shall be rounded to the nearest tenth of a kWh; otherwise, they shall be rounded to the nearest kWh, as specified in Section 8.2 *Rounding* of the Federal Test Procedure, for reporting on the ENERGY STAR website.

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 General Requirements

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

i. Single- and Multiple-voltage EPSs shall include the Level VI or higher marking.
ii. Additional information on the Marking Protocol is available at http://www.regulations.gov/#!documentDetail;D=EERE-2008-BT-STD-0005-0218.

3.2.2 General User Information: The product shall ship with consumer informational materials located in either (1) the hard copy or online electronic user manual, or (2) a package or box insert. These materials shall include:

i. Information about the ENERGY STAR program;
ii. Information on the energy consumption implications of changes to as-shipped TV/HTD configurations and settings, including the implications of software or firmware updates; and
iii. Notification that enabling certain optional features and functionalities (e.g., instant-on), may increase energy consumption beyond the limits required for ENERGY STAR certification, as applicable.

Note: EPA has included a requirement in Section 3.2.2.ii. that information must be provided regarding the energy implications of changes to default settings made via a software/firmware update that may change the power consumption of the product.

3.2.3 Energy Saving Features: A TV/HTD may not be certified with any detectable or undetectable energy saving features that are enabled when tested unless that feature provides comparable energy savings during typical viewing experiences (i.e., the duration of a variety of popular programming). This prohibition applies irrespective of whether the function's primary or intended purpose is energy savings. Further, this applies to features that may be downloaded in the future.

3.2.4 Forced Menu: For any product that includes a Forced Menu where consumers are provided a choice of Home Configuration or Retail Configuration at initial start-up:

i. Upon selection of Retail Configuration, either (1) display a second prompt requiring the user to confirm the choice of Retail Configuration, or (2) display information on the start-up menu that the Home Configuration is the setting in which the product qualifies for ENERGY STAR. If option (2) is selected, additional detail about ENERGY STAR certification and energy consumption expectations shall be included in printed product literature and on the product information page on the Partner's website.
ii. Partners may use alternative terminology if approved by the U.S. Environmental Protection Agency (EPA).

Note: EPA proposes removing the requirements in Version 8.0 Sections 3.2.6 (Manual Adjustments to TV Parameters) and 3.2.7 (Special Functions) because the proposed test procedures in Section 4.4 of this document require the energy saving feature ABC to be disabled during testing.

As TV/HTDs are required to meet Standby Mode power limits in all three of the PPSs tested (per Section 3.4), a product that achieves certification will meet criterion in a range of PPSs. Therefore, EPA proposes to delete the requirement to indicate to consumers which standby settings were certified to ENERGY STAR.

Because Thin Client and MVPD-ready Information technology appears to be rapidly giving way to app-based methods of content streaming, EPA proposes to delete requirements previously placed on such products. If it is believed that Thin Client capabilities are still prevalent in the market or will be again, manufacturers are invited to submit such relevant information for consideration.

3.2.5 Standby-Active, High Mode Capability: TV/HTDs with Standby-Active, High Mode shall automatically return to the as-tested Standby-Active, Low Mode or Standby-Passive Mode following a manufacturer firmware update or other maintenance operation in Standby Active, High Mode within a period less than or equal to 15 minutes from the completion of said update/maintenance operation.

3.3 On Mode Requirements

The following On Mode requirements are based on measurements from a series of On Mode tests outlined in Section 4.4 that are designed to measure how efficiently a TV generates light.

Note: The ENERGY STAR dataset used to develop both On Mode and Standby Mode criteria consisted of over 90 4K LED and 11 high contrast ratio (HCR) models that were available for purchase in 2019 at popular retail locations. The On Mode adjustment factors developed for HCR models were based on this dataset. The adjustment factors for HD and 8K models were established by using the California Energy Commission database to compare HD and 8K model power consumption to the power consumption of 4K models. The proposed criteria outlined in Sections 3.3 and 3.4 achieve an estimated 25% model-based pass rate across EPA's dataset.

3.3.1 For all TV/HTDs, On Mode Power (P_{OA}) metrics, as determined by Section 4.4: *On Mode Tests for All TV/HTDs*, shall be less than or equal to the corresponding Maximum On Mode Power limits (P_{OA_MAX}) as shown in Equations 1, 2, and 3, and are subject to the following requirement:

i. Products shall meet the On Mode Power Requirements for all three Preset Picture Settings indicated by Equations 1, 2, and 3: Default, Brightest, and Default HDR10. Should a TV not have an HDR10 Preset Picture Setting, it will not be subject to that test and shall only meet the Default and Brightest Preset Picture Setting criteria. Should a TV have a Default SDR Preset Picture Setting that is also the Brightest Selectable SDR Preset Picture Setting, then the same test result can be used for $P_{OA\_Default}$ and $P_{OA\_Brightest}$.

Note: EPA is proposing these On Mode Power (P_{OA}) requirements to evaluate performance-based metrics representative of the efficiency with which TV/HTDs produce light in typical picture settings that a consumer may choose to employ. Current research shows that a majority of devices are either left in their default setting or have been put into their brightest setting. As a result, testing in both of these settings is more representative of real-world TV use than testing exclusively in the default setting. Additionally, with broadcast TV transitioning to HDR, the HDR10 PPS (HDR10 being a proxy for all HDR content for now, as it is the minimum specification) is expected to be much more commonly used. Thus, this will be a third PPS required to be tested and meet criteria for purposes of certification.

The On Mode Power metrics obtained by testing these three PPSs per Section 4.4 and evaluated per the On Mode Power Requirement equations are separate from the On Mode Power metric obtained per the Federal Test Procedure, labeled P_{On}, which must also be reported for certification under ENERGY STAR.

Equation 1: On Mode Power Requirement for the Default SDR Preset Picture Setting

$$P_{OA\_Default} \leq P_{OA\_Default\_MAX} \text{ x } AF$$

Where:

- $P_{OA\_Default}$ *is the On Mode Power measured for the default SDR Preset Picture Setting, as measured per Section 4.4, in watts;*
- $P_{OA\_Default\_MAX}$ *is the maximum On Mode Power for the default SDR Preset Picture Setting, in watts, calculated from the corresponding* ***Error! Reference source not found.****in Table 1; and*
- *AF is the Adjustment Factor, dependent on the TV/HTD meeting physical parameters as defined in Section 1, calculated from the corresponding equation in Table 2.*

Equation 2: On Mode Power Requirement for the Brightest SDR Preset Picture Setting

$$P_{OA\_Brightest} \leq P_{OA\_Brightest\_MAX} \text{ x } AF$$

Where:

- $P_{OA\_Brightest}$ *is the On Mode Power measured for the brightest SDR Preset Picture Setting, as measured per Section 4.4, in watts;*
- $P_{OA\_Brightest\_MAX}$ *is the maximum On Mode Power for the brightest SDR Present Picture Setting, in watts, calculated from the corresponding equation in Table 1; and*
- *AF is the Adjustment Factor, dependent on the TV/HTD meeting physical parameters as defined in Section 1, calculated from the corresponding equation in Table 2.*

Equation 3: On Mode Power Requirement for the Default HDR10 Preset Picture Setting

$$P_{OA\_HDR10} \leq P_{OA\_HDR10\_MAX} \text{ x } AF$$

Where:

- P_{OA_HRD10} *is the On Mode Power measured for the Preset Picture Setting automatically enabled when playing HDR10 content, as measured per Section 4.4, in watts;*
- $P_{OA\_HRD10\_MAX}$ *is the maximum On Mode Power for the Preset Picture Setting enabled when playing HDR10 content, in watts, calculated from the corresponding equation in Table 1; and*
- *AF is the Adjustment Factor for the Preset Picture Setting, dependent on the TV/HTD meeting physical parameters as defined in Section 1, calculated from the corresponding equation in Table 2.*

Table 1: Maximum Values for On Mode Power Metrics, P_{OA}

Preset Picture Setting	**Functions:** (P_{OA_MAX} is the lesser of the two limits)	
	Limit 1: Performance-based efficiency limit	Limit 2: Power cap
Default	1.08 x ((0.001 x A + 0.38) x $DL_{Default}$ + (0.009 x A + 18.1))	1.1 x ((0.072 x A) + 17.14)
Brightest	1.08 x ((0.001 x A + 0.28) x $DL_{Brightest}$ + (0.007 x A + 17.1))	1.1 x ((0.089 x A) + 13.65)
HDR10	1.08 x ((0.002 x A + 0.38) x DL_{HDR10} + (0.014 x A + 17.7))	1.1 x ((0.089 x A) + 10.12)

Where:

- *The lesser value calculated from the two functions indicated for the applicable Preset Picture is to be used as P_{OA_MAX} for that setting in the On Mode Power Requirement equations.*

Table 2: Maximum On Mode Power, P_{OA_MAX}, Adjustment Factors

P_{OA_MAX} Adjustment Factor (AF)	Value
$HD_{\_Adjustment}$	1.75 x $(DL \times A)^{-0.08}$
$4K_{\_Adjustment}$	1
$4K\_HCR_{\_Adjustment}$	1.25
$8K_{\_Adjustment}$	5.63 x $(DL \times A)^{-0.11}$

Where:

- *A is the viewable Screen Area of the product in square inches;*
- *DL is the Dynamic Luminance measured for the Preset Picture Setting;*
- *Adjustment factors are applied to TV/HTDs that possess the resolution characteristics for which each is named (e.g., A TV/HTD with the resolution of an HD display incorporates the HD adjustment factor into the appropriate On Mode Power Requirement equation);*
- *The 4K_HCR adjustment factor applies to TV/HTDs with a 4K resolution and a contrast ratio of at least 1,000,000:1;*
- *For TV/HTDs possessing a resolution other than those with a determined adjustment factor, incorporate the adjustment factor of the horizontal resolution immediately below it (e.g., A display with a 5000x2900 pixel resolution should apply the 4K adjustment factor into the appropriate On Mode Power Requirement equation); and*
- *For TV/HTDs with a resolution less than that* defined by the *HD Display definition (i.e. 720p), the HD adjustment factor shall apply.*

Note: EPA has developed these performance-based efficiency limits for the Default SDR, Brightest SDR, and Default HDR10 PPSs to promote the development of TVs that generate light more efficiently. Limit 1, the performance-based efficiency limit, promotes the development of TVs that generate light more efficiently in terms of power per luminance x area. Limit 2, the power cap limit, provides a mechanism to limit extremely bright backlight settings for the three PPSs tested.

The proposed HD, 4K, and 8K Adjustment Factors in Table 2 adjust the Maximum On Mode Power limit according to the power consumption of several distinct classes of display resolution. EPA developed these Adjustment Factors by determining how energy consumption varies with different screen resolutions. In examining the current market, it appears that the majority of TV/HTDs for sale consist of those with resolutions for which the adjustment factor has been tailored. If there is reason to expect that there should be an increase in the market share of other resolution standards (e.g. 720p, 2K, etc.), stakeholders are invited to provide such relevant information for consideration.

The High Contrast Ratio (HCR) Adjustment Factor (4K_HCR) was derived after testing HCR capable 4K models. There are not enough HD or 8K models with HCR capabilities available to consumers from which to assess the need for separate HD_HCR or 8K_HCR Adjustment Factors. EPA expects that as the market for 8K TVs grows, more HCR capable models will become available. However, until enough models are available to form a dataset, an 8K HCR Adjustment Factor cannot be determined. If there is data available, EPA would appreciate information regarding the need for a separate 8K HCR adjustment factor (currently an 8K HCR capable TV would qualify for the 8K adjustment factor). Stakeholders are invited to provide additional data for consideration in developing appropriate Adjustment Factors as part of their written feedback to Draft 1. Also, EPA understands that Quantum Dot Color Conversion technology has the potential to significantly reduce energy consumption of HCR TVs. EPA requests additional information about the magnitude of savings and market timing for this technology, which may cause EPA to reconsider the need for an HCR adjustment factor.

EPA believes these performance-based criteria will encourage more efficient product design through the adoption of efficient components (e.g., LEDs, films, power supplies, etc.) and energy saving features (e.g., local dimming). These criteria also eliminate the need for luminance requirements, allowing for a wide range of luminance settings while ensuring that luminance is provided efficiently. In doing so, this approach provides manufacturers more flexibility and an incentive to deliver light efficiently (i.e., more efficient TVs can be brighter than less efficient TVs). As a result of this proposal, EPA has removed Section 3.6 *Luminance Requirements* from Version 8.0 for Version 9.0.

3.4 Standby Mode Requirements

The following Standby Mode Requirements are based on measurements from the Federal Test Procedure Standby-Passive Mode Test as well as a series of additional Standby-Active, Low Mode tests outlined in Section 4.6, that are designed to measure standby power in a more typical network environment (e.g. multicast traffic on the network).

3.4.1 Standby-Passive Mode power ($P_{STANDBY\text{-}PASSIVE}$), as measured per Section 7.3.*2 Standby-Passive Mode* of the Federal Test Procedure, shall be less than or equal to 0.5 W.

3.4.2 For TVs capable of network connectivity, Standby-Active, Low Mode Power ($P_{STANDBY-ACTIVE-LOW}$), as measured per Section 7.3.3 *Standby-Active, Low Mode* of the Federal Test Procedure, shall be less than or equal to 2.0 W.

3.4.3 For TVs capable of network connectivity, Additional Standby-Active, Low Mode power ($P_{ADDITIONAL-STANDBY-ACTIVE-LOW}$), as measured per Section 4.6: *Additional Standby Mode Tests*, shall be less than or equal to 2.0 W.

i. TV/HTDs must meet Additional Standby-Active, Low Mode power requirements in each of the three Present Picture Settings identified in Section 3.3.3.i: Default SDR, Brightest SDR, and Default HDR10 for both tests without and with a smart speaker (4.6.1 and 4.6.2, respectively).

Note: Standby-Passive testing is intended to be conducted per the Federal Test Procedure and the criteria proposed here remains unchanged. However, the Additional Standby-Active Low Mode is proposed to be tested according to the Federal Test Procedure *and* the additional testing outlined in Section 4.6.

EPA is interested in exploring the relationship between different PPSs and Standby Mode power consumption. If standby power consumption does not vary based on PPS employed while in On Mode, the repetitive Standby Mode testing of TV/HTDs in different PPSs may be unnecessary. As a result, EPA welcomes stakeholder data relevant to the relationship between Standby Power and the PPS enabled.

3.5 Download Acquisition Mode (DAM) Requirements for Hospitality TV/HTDs

3.5.1 A product may automatically exit Standby-Passive Mode or Standby-Active, Low Mode and enter Download Acquisition Mode according to a predefined schedule, in order to:

i. Download channel listing information for use by an electronic programming guide,
ii. Monitor for emergency messaging/communications, or
iii. Communicate via a network protocol.

3.5.2 DAM energy consumption for all DAM states (E_{DAM}), as measured per the CEA Procedure for DAM Testing, shall be less than or equal to 40 watt-hours per day (0.04 kWh/day).

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

4 TESTING

4.1 Federal Test Procedure

Test methods identified in Table 3 shall be used with out-of-box software before performing any additional tests:

Table 3: Test Method for All TV/HTDs

Applicability	Test Method
All AC Mains-powered TV/HTDs	Uniform Test Method for Measuring the Energy Consumption of Television Sets incorporated in Appendix H to Subpart B of 10 CFR Part 430

Note: To the extent that the Department of Energy requires use of the Federal Test Procedure, EPA will collect P_{On} test results for listing as part of the information provided by ENERGY STAR Product Finder.

4.2 Software Update

4.2.1 All TV/HTDs shall execute a software update before performing any tests in Section 4.3, 4.4, 4.5, and 4.6 via the following steps:

i. Download and install any available software updates either by acknowledging a prompt or by requesting an update through a menu selection.
ii. Wait until all software updates have been installed.

Note: EPA has removed the requirement to retest products to all applicable test procedures after a software update has been complete, if available. Instead, EPA has required that a software update be complete before all tests in Section 4.3, 4.4, 4.5, and 4.6 below. EPA believes this will capture any changes in power consumption resulting from software updates, while eliminating some test burden. Also, EPA has removed the additional HDR upscaling and luminance tests since EPA is now requiring testing in the HDR10 picture setting, as well as measuring dynamic luminance per the tests in Section 4.4.

4.3 Additional DAM Test for Hospitality TV/HTDs

DAM energy consumption of Hospitality TV/HTDs shall be measured using the following method in Table 5:

Table 4: Method for DAM Test for Hospitality TV/HTDs

Applicability	Method
Additional DAM Test for Hospitality TV/HTDs	Annex D of CTA/ANSI-2037-B, Feb 2018

4.4 On Mode Tests for All TV/HTDs

For the following tests, measurement, test preparation and configuration requirements are determined by the Federal Test Method prescribed in Table 3, except where the following test procedure indicates otherwise.

4.4.1 Camera Photometer Requirements

The On Mode tests require the measurement of Dynamic Luminance with a camera photometer – equipment and set-up requirements are defined here. Dynamic Luminance shall be measured with a monochrome camera photometer that meets the following requirements:

i. Capable of measuring screen-average luminance (in cd/m2) during video test clip play with TBD% accuracy as measured by TBD;
ii. Able to sample data at 6 fps without dropping data between frames and to log data at 1 second intervals;
iii. Minimum resolution of 720 x 540 pixels;
iv. Master black correction;
v. Vignette correction;
vi. Geometry correction; and
vii. 12-bit dynamic range.

Note: The camera photometer approach was developed in conjunction with DOE and is being reviewed by IEC for consideration in future revisions of IEC 62087. Camera photometer performance evaluation is in progress. Preliminary results suggest that the use of color correction factors can achieve low cost and high accuracy measurements. The above accuracy metric labeled as TBD will be specified once the appropriate color correction factors are determined. EPA expects these metrics to be included in the Draft 2 Specification.

4.4.2 Camera Photometer Set-up

i. The camera photometer shall be positioned at a distance of 1.0 to 1.1 times the TV/HTD screen diagonal dimension away from the center of the screen, pointing at the center of the screen. For example, the camera photometer should be placed 55" to 60.5" away from a 55" TV.
ii. The camera must be stabilized before testing is conducted, requiring a 60-minute warm-up (dependent on the model), and set to log data at 1 second intervals.
iii. The camera shall be focused on the screen and the appropriate vignette correction file for that focus distance must be used for the test.

4.4.3 On Mode Tests

All testing shall be performed with ABC and Motion Detection Dimming turned off. The following test sequence shall be used to determine power and luminance measurements. Measure and record the average power (P_{OA}) and dynamic luminance for the following tests:

i. SDR Default Preset Picture Setting with *IEC 62087 Ed. 3.0 Blu-ray Disc™ Dynamic Broadcast-Content Video Signal*.
ii. SDR Brightest selectable Preset Picture Setting with *IEC 62087 Ed. 3.0 Blu-ray Disc™ Dynamic Broadcast-Content Video Signal*.
iii. HDR10 Default Preset Picture Setting with IEC 62087 provisional HDR10 dynamic test clip

If it is possible to manually adjust the backlight setting of the unit under test, repeat these tests in the dimmest manual backlight setting.

Note: EPA proposes that all testing performed for purposes of ENERGY STAR certification be performed with ABC turned off. EPA does however recognize the potential saving opportunities that a well-programed ABC feature can deliver to consumers. As a result, when a test method is introduced to allow for a better understanding of the relationship between ABC's persistence and energy consumption, reintroducing requirements for ABC-implementation can be evaluated.

Future ENERGY STAR TV Specification revisions will require an understanding of TV/HTD dimming lines when power is plotted against dynamic luminance for multiple backlight levels. As such, EPA requests test results in the dimmest manual setting for each of the three PPSs tested.

If the SDR Default PPS is also the SDR Brightest Selectable PPS, then there is no need to test this PPS twice.

4.5 High Contrast Ratio Test

For this test, measurement, test preparation and configuration requirements are determined by the Federal Test Method prescribed in Table 3, except where the following test procedure indicates otherwise.

i. Configure the TV in its SDR Default Preset Picture Setting with MDD and ABC off.
ii. Display the rtings.com contrast ratio test pattern[19].
iii. If it is possible to manually adjust the backlight setting of the unit under test, set the display backlight level so that the screen-center luminance is approximately 100+/-5 cd/m^2 as measured in center 1% of screen with camera photometer.
iv. Measure the luminance in the center of the black box immediately above screen center using camera photometer with a 1% measurement window located in the middle of the aforementioned black box.
v. Calculate contrast ratio as $Luminance_{\_white}$/$Luminance_{\_black}$

Note: Calculating the contrast ratio per Section 4.5 will determine whether a model receives the HCR-based adjustment factor and provide metrics from which to establish a relationship between contrast ratio and energy consumption for future specification revisions.

19 https://s3.amazonaws.com/rtings/130.png

4.6 Additional Standby Mode Tests

Additional standby-active, low power and wake-time measurements shall be conducted in the SDR Default Preset Picture Setting configuration with updated software and active LAN and WAN connections, and then repeated in the SDR Brightest and Default HDR10 Preset Picture Settings. The LAN shall have no other devices on it except for a network traffic generator, which will be used to generate TBD load of network traffic.

Note: EPA has observed that some TVs use significantly more power (e.g. > 10 watts) in standby-active, low when Multicast DNS requests are present on the network. These are packets broadcast by an application (e.g. Spotify, YouTube) on one device (e.g. iPhone) requesting identification (i.e. local IP addresses, device profiles) from other devices on the subnet. The traffic may be unrelated to the TV, but the TV responds to notify the network that it is ready to receive casted content and then stays ready at a higher power level for a period of time. Research is needed to further characterize this TV behavior and to develop a network traffic test environment that is representative and repeatable using a packet generator (i.e. Ostinato). After that is developed, EPA will include the metrics currently labeled as TBD above.

EPA is open to inclusion of text similar to that in CTA-2043-B, STB test method: “Review the captured power samples. If, during the 60 minutes of samples, it appears that a maintenance activity occurred (e.g. the power consumption spikes up for a short duration), re-run the test. Using a charting utility (such as the utility in Microsoft Excel) can help to analyze the results.” EPA notes, however, that the direction to update software before testing and the development of a network test environment is intended to limit the possibility of a maintenance event and spikes related to LAN traffic during testing, respectively. Stakeholders are invited to comment on the proposed tests.

4.6.1 Without Smart Speaker

i. Standby-active, low shall be measured with the TV in its default configuration without a connection to a smart speaker or other device besides the LAN equipment used for testing.
ii. At the end of the standby test period, wake time should be measured by pressing the power button on the remote control and measuring the time period before an active HDMI SDR video feed (e.g. looped IEC test clip) appears on the display.
iii. The SDR video clip shall be playing before TV power-down through wake. For TVs with a Quick Start (QS) feature that is disabled by default: if the wake time is equal to or greater than 10 seconds, perform this standby-active, low test with QS enabled to enable compliance determination.

Note: The wake time condition included to determine whether a TV/HTD would be tested with Quick Start enabled is consistent with the industry-standard CTA/ANSI-2037-B ten-second QS persistence rule (Section 6.3.10.6.3).

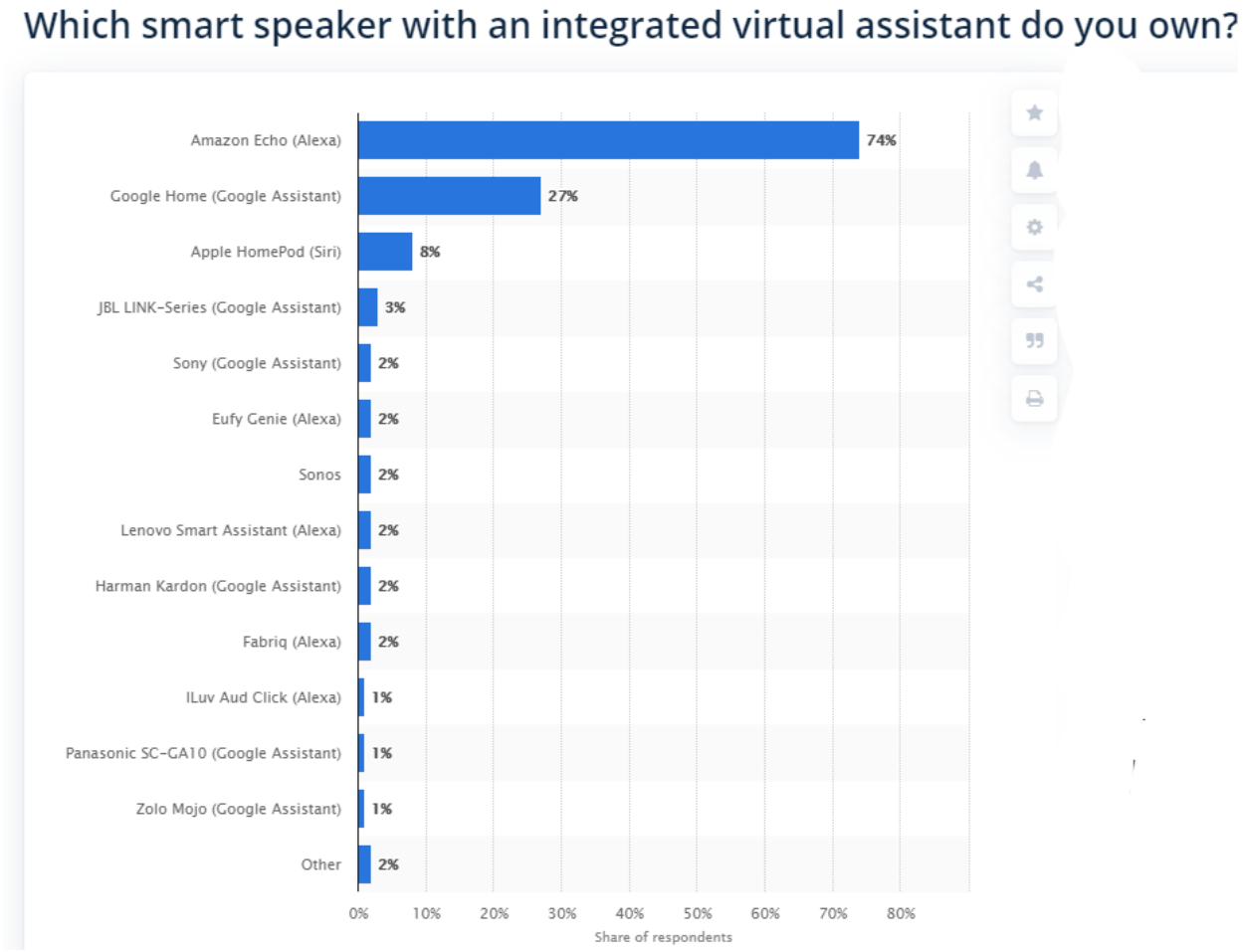
4.6.2 With Smart Speaker

Where the TV supports the capability, Standby-Active, Low Power and wake time shall be measured with the TV in its default configuration and a smart speaker manufactured by Amazon connected and configured to wake the TV.

i. This test should be repeated for a smart speaker manufactured by Google after disabling the Amazon speaker connection to the TV.
ii. For each of these tests measure voice-wake time to an active HDMI SDR video feed, which shall be playing before TV power-down through wake.
iii. For TVs with a Quick Start (QS) feature, disable this feature before testing with a Smart Speaker.

Note: EPA proposes to conduct testing with a smart speaker connected after all other additional tests to avoid requiring the performance of a factory reset on the TV/HTD to restore factory default settings. Configuring a smart speaker to wake a TV/HTD may involve logging into a personal account held with the speaker manufacturer on both products (a Google account for example).

Testing with multiple types of smart speaker is required, as previous testing has shown variation in energy consumption with different brand, a relationship which EPA seeks to understand more about. Amazon and Google smart speakers have been identified for these tests because their digital assistant products represent the largest market shares (both current and forecasted) by a wide margin.



The above chart, sourced from Statista, is one of many that shows that if a TV is paired with a digital assistant today, it is likely to be from Amazon or Google. The brand with the next largest current share has far less penetration and is not currently configured to control non-Apple devices.

4.7 Number of Units Required for Testing

4.7.1 One of the following sampling plans shall be used to test for ENERGY STAR certification:

i. A single representative unit shall be selected for testing the Basic Model;
ii. Units shall be selected for testing per the sampling requirements defined in 10 CFR 429.25, which references 10 CFR 429.11.

4.8 International Market Certification

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

5 USER INTERFACE

5.1.1 Partners are encouraged to design products in accordance with the user interface standard IEEE 1621: Standard for User Interface Elements in Power Control of Electronic Devices Employed in Office/Consumer Environments. For details, see http://eetd.LBL.gov/Controls.

6 EFFECTIVE DATE

6.1.1 Effective Date: The Version 9.0 ENERGY STAR Televisions specification shall take effect on **TBD**. 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.

Note: The effective date is tentative until the date of final publication of the ENERGY STAR Televisions Version 9.0 Specification. The Version 9.0 specification will take effect 9 months after that date.

6.1.2 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.

7 CONSIDERATIONS FOR FUTURE REVISIONS

7.1.1 Backlight Control Accessibility and ABC Persistence: EPA seeks to understand if more accessible backlight controls would increase ABC persistence. EPA plans to include ABC criteria in future revisions, once IEC MT62087 aligns on an updated approach to ABC testing.

7.1.2 Implementation of Filmmaker Mode and Performance: EPA is interested to see if the increased implementation of a “Filmmaker Mode” Preset Picture Setting by manufacturers is followed by a tendency to apply the setting by consumers and how the characteristics unique to this setting affect energy efficiency.

7.1.3 Color Quality and Energy Efficiency: EPA looks to explore the relationship between image quality, with respect to color (viewing angle, gamut size, etc.), and energy efficiency.

Note: Items in this section have been removed as many have been addressed in this Version 9.0 Specification. EPA has added the items above as they represent emerging technological advances that should be studied in future revisions.