# ENERGY STAR® Program Requirements for Televisions

## Eligibility Criteria
## Draft Version 9.1

Following is the Draft Version 9.1 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]

**Note:** Below are the definitions of the relevant terms In this document. Where noted below, definitions are identical to the definitions in the U.S. Department of Energy (DOE) test procedure at 10 Code of Federal Regulations (CFR) 430, Subpart B, Appendix H or in 10 CFR 430.2. When in conflict, the definitions in the CFR take precedence.

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:

[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

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

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) Terms codified in Appendix H, defined according to section 5.1 of ANSI/CTA-2037-D:

5) Annual Energy Consumption (AEC): The total amount of energy predicted to be used by a Television Set a year.

6) Automatic Brightness Control (ABC): Feature that senses ambient light conditions and changes display brightness accordingly, possibly reducing power consumption.

7) Brightest Selectable Preset Picture Setting: This is the user-selectable, Preset Picture Setting (PPS) that produces the highest Luminance picture in Home Configuration.

8) Default Preset Picture Setting: Out-of-the-box picture setting for Television Sets in the Home Configuration.

9) Dynamic Luminance (DL): Screen average luminance measured as average luminance across the entire display are of a TV during the playback of dynamic video content, measured from a typical viewing distance.

10) Energy-Efficient Ethernet: A set of enhancements to the twisted-pair and backplane Ethernet family of computer networking standards (IEEE 802.3) that reduce power consumption during periods of low data activity.

11) Filmmaker Mode: A Preset Picture Setting promoted by the UHD Alliance that disables all post-processing (e.g., motion smoothing, etc.) and preserves the correct aspect ratios, colors, and frame rates.

12) Forced Menu: Configuration selections required of the user when a Television Set is turned on for the first time that force the user to make set-up configuration decisions when prompted.

13) Gloss Unit: A unit used to measure the specular reflectance of a surface.

14) HDR10: High Dynamic Range 4:2:0 10-bit video conforming to Rec. ITU-R BT.2100 Table 4 (PQ), color primaries conforming to Red. ITU R BT.2100 Table 2, and static metadata confirming to SMPTE ST 2086.

15) High Dynamic Range (HDR): High Dynamic Range (HDR) video uses greater bit depth, luminance, and color space than standard dynamic range (SDR) video. It utilizes perceptual quantizer (PQ) tone curves as specified in Red. ITU-R BT 2100 Table 5 (instead of samma, as used with SDR). When HDR video is rendered on an HDR display, it is possible to see greater luminance ranges and wider color gamut.

16) Home Configuration: The configuration most likely to be chosen for home use. This configuration selection is sometimes named “home”. If there is no associated forced menu selection, the unit is in Home Configuration if it is not in Retail Configuration. Home Configuration corresponds to Normal Configuration as defined in IEC 62087.

[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.

17) Hybrid Log Gamma: High Dynamic Range video conforming to Rec. ITU-R BT.2100 Table 5 (Hybrid Log Gamma).

18) Illuminance: Photometric measure of the total luminous flex incident on a surface per unit area, expressed in lux.

19) International System of Units: The modern form of the metric system.

20) Luminance: Photometric measure of the luminous intensity per unit area of light traveling in a given direction, expressed in units of candelas per square meter ($cd/m^2$).

21) Main Battery: Power storage device capable of powering equipment such that the equipment can provide its primary functions.

22) Motion-Based Dynamic Dimming (MDD): Television feature that adjusts luminance in response to amount of motion in the displayed image.

23) ND Filter (Neutral Density Filter): Optical device that reduces the light intensity in the visible wavelength region.

24) On Mode: A Power Mode in which the UUT is connected to an external power source and providing picture and, if possible, sound.

25) Perceptual Quantization Video (PQ): Video as described in Rec. ITU-R BT.2100 Table 4.

26) Preset Picture Setting (PPS): TV picture setting that is selectable by a user from a set of manufacturer-defined picture settings.

27) Quick Start: Function that reduces the television's resume time, which is the length of time required for the television to display content when switching from Standby Mode to On Mode.

28) Retail Configuration: The configuration intended for use in a retail environment. This configuration selection is generally recommended by the manufacturer for presentation in a public space when the television set is offered for sale and might be named, "Retail," "Store," "Shop," or equivalent.

29) Snoot: A tube or similar object that fits over a light source and controls the direction and radius of the light beam. A Snoot can be conical, cylindrical, or rectangular in shape.

30) Software: For the purposes of this standard, "Software" means code that runs on the UUT, whether the code facilitates user interaction or not. This term is used in this document to refer to code that can be updated, either by transferring updated code from a USB stick or by downloading updated code from the internet. In this context, code that might be classified as "firmware" elsewhere is classified as "Software" here.

    a) Wake-By-Remote-Control-App: The ability to wake a TV using any network-connected device not physically connected to the TV.

    b) Wake-By-Smart-Speaker: The ability to wake a TV by voice command to a smart speaker.

    c) Wake-On-Cast: The ability to wake a TV by choosing to cast streaming audio or video from a smartphone.

C) Terms codified in 10 CFR 430.2, defined according to section 5.1 of ANSI/CTA-2037-D:

31) High-Definition Multimedia Interface (HDMI): Means an audio and video interface as defined by HDMI ® Specification Informational Version 1.0 or greater.

32) Standby Mode: Means the condition in which an energy-using product:

a) Is connected to a main power source; and

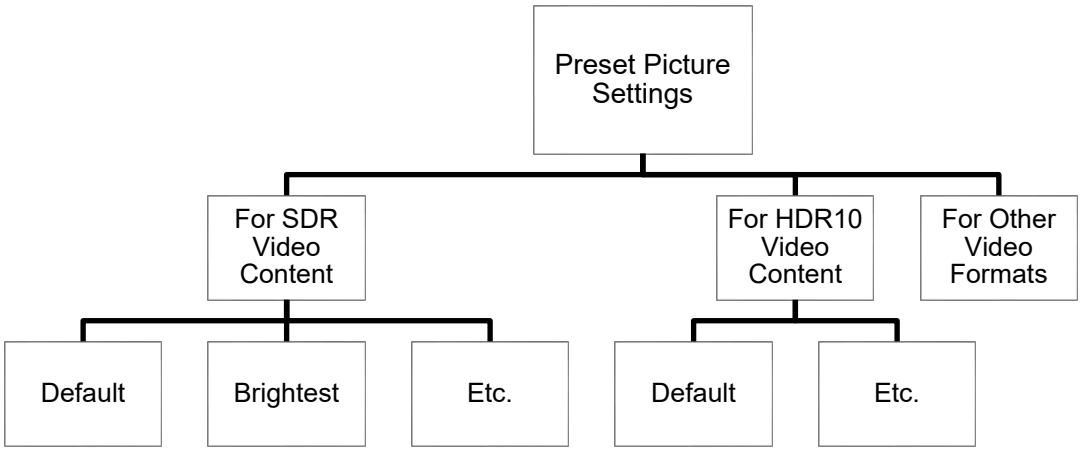
b) Offers one or more of the following user-oriented or protective functions:

i) To facilitate the activation or deactivation of other functions (including active mode) by remote switch (including remote control), internal sensor, or timer; or

ii) Continuous functions, including information or status displays (including clocks) or sensor-based functions.

32) Default HDR10 Preset Picture Setting: The as-shipped Preset Picture Setting when playing HDR10 content. This setting may not always be available for manual user selection and may instead be automatically entered when an HDR10 input signal is detected.

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




33) 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.

34) 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).

35) 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).

36) Contrast Ratio: The ratio between the luminance of the brightest white and the darkest black that a TV can produce.

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

# 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 shall be rounded to the nearest kWh; as specified in Appendix H, 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 tenth as specified in Appendix H.

**Note:** EPA updated rounding requirements for reported values. The purpose of doing so was to align the specification with Appendix H to Subpart B in 10 CFR 430. Annual Energy Consumption (AEC) reported values shall be rounded to the nearest kWh, and directly measured or calculated reported values shall be rounded to the nearest tenth, as specified in Appendix H.

## 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.

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 common or prevalent 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, the product must 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).

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.

**Note:** EPA removed the Standby-Active, High Mode Capability requirement in 3.2.5 which indicated that TVs/HTDs must return to a lower power standby 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 the update/maintenance operation since there is only one Standby Mode defined in Appendix H. As a result, this requirement is no longer necessary.

## 3.3 On Mode Requirements

The following On Mode requirements are based on measurements taken per Appendix H to Subpart B in 10 CFR 430.

**Note:** EPA has made significant changes to section 3.3. As Appendix H to Subpart B in 10 CFR 430 references ANSI/CTA-2037-D, which includes equations for calculating DL and $P_{OA}$ for each PPS and $P_{OA}$ averaged across all PPSs, EPA has removed these equations from the Version 9.1 specification as compared to Version 9.0. The Version 9.1 specification requires the use of Appendix H to determine these values.

3.3.1 Products shall meet the On Mode Power Requirement as outlined by Equation 1:

**Equation 1: On Mode Power Requirement**

$$P_{OA\_Average} \leq P_{OA\_Average\_Limit} \text{x } AF$$

Where:

- $P_{OA\_Average}$ is the power used to determine certification. It is the average of the On Mode Power in each applicable preset picture setting as calculated per Appendix H, where $P_{OA\_Average\_Limit}$ for each preset picture setting is subject to the interpolation requirements of section 3.3.3., in watts;
- $P_{OA\_Average\_Limit}$ is the average limit of On Mode Power in each applicable preset picture setting as calculated per Equation 2, in watts; and
- AF is the Adjustment Factor, dependent on the TV/HTD, calculated from the corresponding equations in Table 2.

**Equation 2: Average Limit of On Mode Power, $P_{OA\_Average\_Limit}$**

$$P_{OA\_Average\_Limit} = \frac{P_{OA\_Default\_Limit} + P_{OA\_Brightest\_Limit} + P_{OA\_HDR\_Limit}}{n}$$

Where:

- $P_{OA\_Average\_Limit}$ is the average limit of On Mode Power in each applicable preset picture setting as calculated per Equation 5, in watts;
- $P_{OA\_Default\_Limit}$ is the limit for On Mode Power of the Default SDR Preset Picture Setting, as determined by Table 1, in watts;
- $P_{OA\_Brightest\_Limit}$ is the limit for On Mode Power of the Brightest SDR Preset Picture Setting, as determined by Table 1, in watts;
- $P_{OA\_HDR\_Limit}$ is the limit for On Mode Power of the Default HDR Preset Picture Setting, as determined by Table 1, in watts; and
- *n* is the number of PPSs for which DL and $P_{OA}$ metrics have been gathered (i.e., n equals 2 if the TV/HTD is not capable of displaying HDR content).

**Table 1: On Mode Power Limits**

| Preset Picture Setting | Functions: | |
|---|---|---|
| | Limit 1: Performance-based efficiency limit | Limit 2: Power cap |
| Default ($P_{OA\_Default\_Limit}$) | 0.94 x ((0.0007 x A + 0.5736) x $DL_{\_Cert}$ + (0.0055 x A + 18.9667)) | 1.15 x ((0.0249 x A) + 46.5902) |
| Brightest ($P_{OA\_Brightest\_Limit}$) | 0.94 x ((0.0007 x A + 0.5424) x $DL_{\_Cert}$ + (0.005 x A + 19.8365)) | 1.15 x ((0.0819 x A) + 18.4228) |
| HDR10 ($P_{OA\_HDR\_Limit}$) | 0.94 x ((0.0013 x A + 1.866) x $DL_{\_Cert}$ + (0.0069 x A + 17.1106)) | 1.15 x ((0.0576 x A) + 31.6067) |

Where:

- $DL_{\_Cert}$ is the dynamic luminance for the Preset Picture setting, as determined in Appendix H, subject to the interpolation requirement in section 3.3.3;
- A is the viewable Screen Area of the product in square inches; and
- The lesser of the two limit values calculated for a Preset Picture Setting is to be used in the $P_{OA\_Average\_Limit}$ calculation.

3.3.2 If the value for the DL used to represent an SDR PPS per Appendix H is measured or calculated to be less than 20 cd/m$^2$, then 20 cd/m$^2$ shall be the DL value used to represent the PPS for the purpose of determining certification ($DL_{\_Cert}$), and the value of $P_{OA}$ used to represent the PPS shall be the interpolated $P_{OA}$ value of the PPS ($P_{OA\_Cert}$) when the TV/HTD is set to a DL of 20 cd/m$^2$. Likewise, if the value of the DL for an HDR10 PPS is less than 10 cd/m$^2$, then 10 cd/m$^2$ shall be used as the DL representing the PPS for the purpose of determining certification, and the value of $P_{OA}$ used to represent the PPS shall be the interpolated $P_{OA}$ value of the PPS when the TV/HTD is set to a DL of 10 cd/m$^2$.

a) For PPSs with ABC enabled by default (including the Brightest PPS), the $P_{OA}$ values of a PPS correlating to a projected DL of 20 cd/m$^2$ or 10 cd/m$^2$ shall be calculated through interpolation of the 2nd order polynomial trendline created by plotting all the PPS's measured $P_{OA}$ value datapoints against the measured DL values at the same points.

b) For PPSs without ABC enabled by default, the $P_{OA}$ values of a PPS correlating to a projected DL of 20 cd/m$^2$ or 10 cd/m$^2$ shall be calculated through interpolation of the linear trendline created by plotting the minimum backlight (set per Appendix H to Subpart B of 10 CFR Part 430) and default backlight $P_{OA}$ value datapoints against the measured DL values at the same point.

**Note:** EPA updated the requirement for interpolating the $P_{OA}$ of a PPS without ABC enabled if the DL used to represent the SDR PPS is measured or calculated to be less than 20 cd/m$^2$ or 10 cd/m$^2$. Instead of including the ABC enabled datapoints to create a 2nd order polynomial, a linear trendline should be created by plotting the minimum backlight and default backlight $P_{OA}$ value datapoints against the measured DL values at the same point. EPA is requiring linear interpolation to avoid a scenario where a previously passing TV (under Version 9.0) now fails (under Version 9.1) because of the interpolation rule.

**Table 2: Average Limit of On Mode Power, $P_{OA\_Average\_Limit}$, Adjustment Factors**

| $P_{OA\_MAX}$ Adjustment Factor (AF) | Value |
|---|---|
| $AF_{HCR}$ | 1.12 |
| $AF_{Resolution}$ | $(0.0469 \times P^{0.1946})/1.041$ |

Where:

- P is the pixel count of the TV/HTD, calculated by multiplying the TV/HTD's vertical resolution by its horizontal resolution;
- The resolution adjustment factor, $AF_{Resolution}$, applies to all TV/HTDs; and
- The HCR adjustment factor, $AF_{HCR}$, applies to TV/HTDs that are determined by the Certification Body, through evaluation of the TV's display technology, to meet the definition of an HCR Display.

## 3.4 Standby Mode Requirements

Appendix H requires a single, Standby Mode test, and the results are labeled differently depending on which features are present. Below, Standby Mode Power allowances are defined by feature set.

3.4.1 For internet connected UUTs, with or without smart wake features, Standby Mode Power shall be less than or equal to 1.0 W.

3.4.2 For non-internet connected UUTs, Standby Mode Power shall be less than or equal to 0.5 W.

**Note:** Changes to Standby Mode Power requirements were made to align Version 9.1 with Appendix H to Subpart B in 10 CFR 430. Version 9.1 requires that Standby Mode Power requirements be calculated according to Appendix H.

# 4 TESTING

## 4.1 Applicable Test Procedures

The certified values of annual energy consumption (AEC) and power consumption determined according to the U.S. Department of Energy's (DOE's) Federal Test Procedure shall be reported to EPA for presentation in the ENERGY STAR Product Finder.

**Table 3: Test Method for All TV/HTDs**

| Product Type | Test Method |
|---|---|
| All TV/HTDs in scope of V9.1 | Uniform Test Method for Measuring the Energy Consumption of Television Sets incorporated in Appendix H to Subpart B of 10 CFR 430. |

*Only data used to determine compliance with ENERGY STAR requirements must be measured in an EPA-Recognized Laboratory through the Third-Party Certification process.

**Note:** EPA updated the applicable test procedures to reference Appendix H to Subpart B in 10 CFR 430, as amended by the March 15, 2023 DOE Test Procedure Final Rule, 88 FR 16082. The amended test procedure aligns with *ANSI/CTA-2037-D*: Determination of Television Set Power Consumption.

## 4.2 Number of Units Required for Testing

4.2.1 The following sampling plans shall be used to test for ENERGY STAR certification:

i. Units shall be selected for testing per the sampling requirements defined in 10 CFR 429.25, which references 10 CFR 429.11.

## 4.3 International Market Certification

4.3.1 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 ENERGY STAR Televisions specification shall take effect on **October 20, 2022**. 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.

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.

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.