ENERGY STAR® Product Specification for Set-top Boxes

Eligibility Criteria
Draft 2 Version 4.1

Following is the Version 4.1 ENERGY STAR product specification for Set-top Boxes (STBs). A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

1 DEFINITIONS

A) Set-top Box (STB): A device combining hardware components with software programming designed for the primary purpose of receiving television and related services from terrestrial, cable, satellite, broadband, or local networks and providing video output using at least one direct video connection.

B) Displayless Video Gateway: A device combining hardware components with software programming designed for the primary purpose of receiving television and related services from terrestrial, cable, satellite, broadband, or local networks and providing video without any direct video connection.

Note: Per stakeholder comment, EPA has revised the definition of Displayless Video Gateway, simplifying the definition and highlighting that the difference between STB and Displayless Video Gateway is the presence of a local video connection.

<table>
<tr><td colspan="2" rowspan="3"></td><td colspan="3">Primary purpose is receiving television and related services?</td></tr>
<tr><td colspan="2">Yes</td><td rowspan="2">No</td></tr>
<tr><td colspan="2">Local Video Connection?</td></tr>
<tr><td colspan="2"></td><td>Yes</td><td>No</td><td></td></tr>
<tr><td rowspan="2">Direct Service Provider Source Input?</td><td>Yes</td><td>STB</td><td>Displayless Video Gateway</td><td>Small Network Equipment (covered in separate ENERGY STAR Specification)</td></tr>
<tr><td>No</td><td>Thin Client/ Remote STB</td><td colspan="2">Excluded from Scope</td></tr>
</table>

Note: EPA has revised the above table outlining the relationship between various product definitions following the revisions to the definition of Displayless Video Gateway.

C) Product Type (Base Type): The means of access to video content for a STB or Displayless Video Gateway.

1) Cable: A STB or Displayless Video Gateway that can receive television signals from a broadband, hybrid fiber/coaxial, or community cable distribution system with Conditional Access (CA) or a STB capable of receiving cable service after installation of a CableCARD or other type of Conditional Access system.

2) Satellite: A STB or Displayless Video Gateway that can receive and decode video content as delivered from a Service Provider satellite network.

3) Cable Digital Transport Adapter (DTA): A minimally-configured STB that can receive television signals from a broadband, hybrid fiber/coaxial, or community cable distribution system.

4) Internet Protocol (IP): A STB or Displayless Video Gateway that can receive television/video signals encapsulated in IP packets.

i) Over-the-top (OTT) Internet Protocol (IP): An IP STB that cannot receive signals from a Multichannel Video Programming Distributor (MVPD).

ii) Service Provider Internet Protocol (IP): An IP STB that can receive signals from a MVPD.

5) Terrestrial: A STB that can receive television signals over the air (OTA) or via community cable distribution system without Conditional Access (CA).

6) Thin-client / Remote: A STB that can receive content over an HNI from another STB, but is unable to interface directly to the Service Provider network.

Note: In the Draft 1 Version 4.1 specification, EPA had combined the Version 3.0 and 4.0 Base Type definitions and Base Functionality hierarchy, such that a particular STB could meet only one definition. However, based on stakeholder comments, EPA has re-opened the previous Base Type definitions, such that a single STB can meet more than one Base Type definition, based on its functionality ("can receive"), rather than its "primary function" or typical use. Which Base Functionality allowance to apply is now specified in Section 3.3 and Table 1. The intent of these changes is to maintain the same order and allowances as in Version 3.0, while simplifying the definitions and requirements.

D) Additional Functionality:

1) CableCARD: The capability to decrypt premium audio/video content and services and provide other network control functions via a plug-in Conditional Access module that complies with the ANSI/SCTE 28 HOST-POD Interface Standard[1].

2) Digital Video Recorder (DVR): A STB feature that records television signals on a hard disk drive (HDD) or other non-volatile storage device integrated into the STB. A DVR often includes features such as: Play, Record, Pause, Fast Forward (FF), and Fast Rewind (FR). STBs that support a Service Provider network-based "DVR" service are not considered DVR STBs for purposes of this specification. The presence of DVR functionality does not mean the device is defined to be a STB.

3) DOCSIS®: The capability to distribute data and audio/video content over cable television infrastructure in accordance with the CableLabs® Data Over Cable Service Interface Specification[2].

Note: Due to the widespread adoption of Advanced Video Processing and High Definition Resolution, EPA is proposing to eliminate allowances for these functionalities, and, thus, EPA has deleted the relevant definitions in this draft..

4) Home Network Interface (HNI): An interface with external devices over a local area network (example: Institute of Electrical and Electronics Engineers (IEEE) 802.11 (Wireless-Fidelity or Wi-Fi), Multimedia over Coax Alliance (MoCA), HomePNA alliance (HPNA), IEEE 802.3, HomePlug AV) that is capable of transmitting video content.

i) Multi-Input Multi-Output (MIMO) Wireless HNI: IEEE 802.11n/ac and related MIMO enabled Wi-Fi functionality that supports more than one spatial stream in both send and receive. (Antenna support is not relevant, thus the device must be 2 x n : 2[3] or better to fall under this definition.)

5) Multi-room: The capability to provide independent live audio/video content to multiple devices (2 or more Clients) within a single family living unit. This definition does not include the capability to manage gateway services for multi-subscriber scenarios.

Note: EPA has revised the definition of the multi-room adder to only apply to STBs that can provide live

1 http://www.scte.org/standards/
2 http://www.cablelabs.com/specifications/
3 The description "2 x n : 2" means 2 send streams x n antennas : 2 receive streams, where n will always be the same or larger as the largest number of streams (in this case 2).

content and head-end interaction for Thin Client STBs. The adder will no longer apply to STBs that only serve as whole-home DVRs.

Also, per stakeholder comment, EPA has clarified the definition of Multi-room so that it applies more broadly to all single-family units, including apartments in multi-family buildings.

6) Multi-stream: A STB feature that allows the device to read multiple independent streams of video content for use with one or more Clients, one or more directly connected Display Devices, or a DVR, etc. This definition does not include the capability to manage gateway services for multi-subscriber scenarios.

7) Ultra HD (4k) Resolution: The capability to transmit or display video signals with a minimum output resolution of 3840×2160 pixels in progressive scan mode at minimum frame rate of 24 fps (abbreviated 2160p24).

8) High Efficiency Video Processing: Video decoding providing compression efficiency significantly higher than H.264/AVC, for example HEVC (H.265).

9) Three-dimensional (3D) Capability: The capability to transmit or display video signals with 3D depth information for stereoscopic display.

Note: EPA has added definitions for Ultra HD, High Efficiency Video Processing, and 3D Capability; however, EPA is not proposing any allowances for these functionalities at this time due to lack of data on their energy consumption. EPA may consider reasonable allowances in a future STB specification once performance data for these functionalities become available.

Also, as announced in Draft 1, EPA is proposing to eliminate allowances for Removable Media Player and Removable Media Players/Recorders and has therefore deleted the relevant definitions and allowances previously provided in Table 2, below (Section 3.3).

10) Access Point: The capability to provide wireless network connectivity to multiple clients. For the purposes of this specification, Access Point functionality includes only IEEE 802.11 (Wi-Fi) connectivity.

11) Router: The capability to determine the optimal path along which network traffic should be forwarded. Routers forward packets from one network to another based on network layer information. Router functionality includes Access Point functionality.

12) Telephony: The ability to provide analog telephone service through one or more RJ11 or RJ14 jacks.

Note: To permit the qualification of Displayless Video Gateways, which also provide home networking functionality, EPA has provided new adder definitions, based on those in the Version 1.0 ENERGY STAR Small Networking Equipment specification, currently under development.

E) Auto Power Down (APD): A STB feature that monitors parameters correlated with the user activity or viewing. If the parameters collectively indicate that no user activity or viewing is occurring, the APD feature enables the STB to transition to Sleep or Off Mode.

F) Principal Function: Functions necessary for selecting, receiving, decoding, decompressing, or delivering live or recorded audio/video content to a Display Device, local/remote recording device, or Client. Monitoring for user or network requests is not considered a Principal Function for STBs.

G) Secondary Function: Functions that enable, supplement, or enhance a Primary Function including the activation or deactivation of a Primary Function by remote switch (e.g., remote control, internal sensor, and timer).

H) Operational Modes:

1) On Mode: The STB is connected to a mains power source. At least one Principal Function is activated and all Principal Functions are provisioned for use. The power consumption in On Mode may vary based on specific use and configuration.

2) Sleep Mode: A range of reduced power states where the STB is connected to a mains power source and is not providing any Principal Function. The STB may transition to On or Off Mode due to user action, internal signal, or external signal. The power consumed in this mode may vary based on specific use or configuration. If any Principal Function is activated while operating in this mode, the STB is assumed to transition to On Mode. Monitoring for user or network requests is not considered a Principal Function. The STB shall be able to transition from this mode to On Mode within 30 seconds to be considered in Sleep Mode.

   i) Deep Sleep State: A power state within Sleep Mode, characterized by reduced power consumption that provides additional energy savings.

Note: Per stakeholder comment, EPA has revised the definition of Deep Sleep State so that it covers any state that provides additional energy savings over that which is measured by the Sleep Mode test in Section 5.6 of the DOE NOPR. 78 FR 5076.

I) Other Definitions

1) Display Device (DD): A device (e.g., TV, Computer Monitor, or Portable TV) that receives its content directly from a STB through a video interface (example: High-Definition Multimedia Interface (HDMI), Component Video, Composite Video, or S-Video), not through a HNI, and displays it for viewing.

2) Client: A device (e.g., STB, Thin-Client STB, Smart TV, Mobile Phone, Tablet, PC, etc.) that can receive content over a HNI from another STB.

3) External Power Supply (EPS): 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.

4) Service Provider: A business entity that provides video content, a delivery network, and associated installation or support services to subscribers with whom it has an ongoing contractual relationship.

Note: Per stakeholder comment, EPA has clarified the definition of Service Provider so that it mentions "installation or support services" to include organizations with customers who self-install their equipment.

5) Conditional Access: The encryption, decryption, and authorization techniques employed to protect content from unauthorized viewing. CableCARD and Downloadable Conditional Access System (DCAS) are examples of Conditional Access technology.

6) Annual Energy Consumption (AEC): A means for evaluating energy efficiency through a calculation of expected energy consumption for a typical household over a one year period, expressed in units of kWh/year.

7) Unit Under Test (UUT): The STB being tested.

J) Product Family: A group of product models that are (1) made by the same manufacturer, (2) subject to the same ENERGY STAR qualification criteria, and (3) of a common basic design. Product models within a family differ from each other according to one or more characteristics or features that either (1) have no impact on product performance with regard to ENERGY STAR qualification criteria, or (2) are specified herein as acceptable variations within a product family. For Set-top Boxes, acceptable variations within a product family include aesthetic housing changes that do not affect the thermal characteristics of the device (e.g., color, labeling, or other cosmetic modifications).

Note: Numerous stakeholders have commented to EPA and DOE that the definition of a STB basic model, as originally proposed in the DOE Notice of Proposed Rulemaking (NOPR), should be modified, and that DOE should provide additional clarification on what constitutes a STB basic model. EPA and

DOE worked together to develop a solution, which provides the necessary clarifications in the ENERGY STAR specifications, while DOE works through its regulatory process in considering all the comments received on the NOPR.

In the near term, EPA and DOE propose to retain the product family definition and structure for qualification, which allows for updates to the STB firmware or software as long as those changes continue to meet the ENERGYSTAR requirements.

However, DOE and EPA are committed to harmonizing in all aspects of set-top box test procedures. Therefore, EPA intends to migrate the ENERGY STAR specification to the basic model approach once DOE finalizes the test procedure rulemaking for set-top boxes and provides the additional clarify stakeholders are seeking.

EPA and DOE are committed to working together on set-top box test procedures and all references in this draft specification are harmonized with the DOE NOPR (test conditions, AEC calculation, etc.).

2 SCOPE

2.1 Included Products

2.1.1 Products that meet the definition of Set-top Box or Displayless Video Gateway, and a Set-top Box Base Type as specified herein are eligible for ENERGY STAR qualification, with the exception of products listed in Section 2.2.

2.2 Excluded Products

2.2.1 Products that are covered under existing ENERGY STAR product specifications are not eligible for qualification under the STB specification. The list of specifications currently in effect can be found at www.energystar.gov/specifications.

Note: EPA has re-instated Cable DTAs within the scope of Version 4.1 ENERGY STAR specification as stakeholder feedback indicated that service providers remain committed to offering this product type in the near term.

3 QUALIFICATION CRITERIA

3.1 Significant Digits and Rounding

3.1.1 All measured and calculated power values shall be rounded as follows:

i. 0.01 W or better for power measurements of 10 W or less;

ii. 0.1 W or better for power measurements of greater than 10 W and up to 100 W; and

iii. 1 watt or better for power measurements of greater than 100 W.

3.1.2 All measured and calculated energy values shall be rounded as follows:

i. If the computed AEC value is 100 kWh or less, the rated value shall be rounded to the nearest tenth of a kWh.

ii. If the computed AEC value is greater than 100 kWh, the rated value shall be rounded to the nearest kWh.

3.2 General Qualification Criteria

3.2.1 External Power Supplies (EPSs): Single- and Multiple-voltage EPSs shall meet the level V 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 10 CFR Part 430.

i. Single-voltage EPSs shall include the level V marking.

ii. Additional information on the Marking Protocol is available at www.energystar.gov/powersupplies.

3.2.2 Maintenance Activities:

i. Products may automatically exit Sleep Mode and/or Deep Sleep State on a regular schedule to download content, scan for program and schedule information, and perform maintenance activities. The total time spent performing maintenance activities shall not exceed an average of two hours in any 24-hour period, exclusive of activities scheduled by the end-user (e.g., video recording of a regularly scheduled program). Video downloads that are not user-requested (e.g., "speculative recording", or "push") shall be counted against the two hour average per day requirement.

ii. Products that have exited Sleep Mode or Deep Sleep State and completed maintenance or other user-requested activities shall automatically return to Sleep Mode or Deep Sleep State in less than 15 minutes.

iii. Products that provide a speculative recording function shall provide a user-accessible menu option to permit users to disable the functionality. Instructions for disabling speculative recording shall be included in printed and/or electronic product manuals.

3.2.3 Auto Power Down (APD): Products that offer an APD feature shall meet the following requirements:

i. Products shipped with software from the manufacturer shall ship with APD enabled by default, with APD timing set to engage after a period of inactivity less than or equal to 4 hours.

ii. Otherwise, the default software download from the Service Provider shall set APD timing to engage after a period of inactivity less than or equal to 4 hours.

Note: EPA has included the requirement above for APD settings to be downloaded by default following stakeholder comment that not all STBs ship with software loaded.

iii. All energy-related default settings shall persist until an end-user chooses to manually either (1) disable APD, or (2) modify the default settings.

3.3 Annual Energy Consumption (AEC) Requirements

3.3.1 For STBs, AEC as determined per the DOE test procedure, multiplied by a factor relating to the Deep Sleep incentive and the client-only incentive, shall be less than or equal to the Maximum AEC Specification Requirement (AEC_{SPEC_MAX}), as illustrated in Equation 1.

Equation 1: Maximum AEC Specification Requirement for STBs

$$\left(1 - Incentive_{DEEP\_SLEEP} - Incentive_{CLIENT\_ONLY}\right) \times AEC \leq AEC_{SPEC\_MAX} = AEC_{BASE\_MAX} + \sum_{1}^{n} AEC_{ADDL\_i},$$

Where:

- *AEC is the Annual Energy Consumption, as measured in the DOE test procedure;*
- *$Incentive_{DEEP\_SLEEP}$ is an incentive of 17% provided to models with Deep Sleep, as specified in Section 3.3.4; and*

- *$Incentive_{CLIENT\_ONLY}$ is an incentive for Multi-room STBs, as specified in Section 3.3.5;*
- *AEC_{SPEC_MAX} is the maximum AEC Specification Requirement—the level for ENERGY STAR qualification;*
- *AEC_{BASE_MAX} is the topmost applicable Base Type AEC Allowance (kWh), as specified in Table 1; and*
- *AEC_{ADDL_i} is each applicable Additional Functionality AEC Allowance (kWh), as specified in Table 2, applied once per functionality and subject to the requirements in Section 3.3.3, below.*

3.3.2 For Displayless Video Gateways, AEC as determined per Section 4.6, multiplied by a factor relating to the Deep Sleep incentive, shall be less than or equal to the Maximum AEC Specification Requirement (AEC_{SPEC_MAX}), as illustrated in Equation 2.

Equation 2: AEC Requirement for Displayless Video Gateways

$$\left(1 - Incentive_{DEEP\_SLEEP}\right) \times AEC \leq AEC_{SPEC\_MAX} = AEC_{BASE\_MAX} + \sum_{1}^{n} AEC_{ADDL\_i},$$

Where:

- *AEC is the Annual Energy Consumption, as measured in Section 4.6;*
- *$Incentive_{DEEP\_SLEEP}$ is an incentive of 17% provided to models with Deep Sleep, as specified in Section 3.3.4; and*
- *AEC_{SPEC_MAX} is the maximum AEC Specification Requirement—the level for ENERGY STAR qualification;*
- *AEC_{BASE_MAX} is the topmost applicable Base Type AEC Allowance (kWh), as specified in Table 1; and*
- *AEC_{ADDL_i} is each applicable Additional Functionality AEC Allowance (kWh), as specified in Table 2, applied once per functionality and subject to the requirements in Section 3.3.3, below.*

Note: As first proposed in Draft 1 Version 4.1, EPA has removed the distinction between the Base Types and Base Functionalities, which were dependent on the Base Types, but were separate categories used to calculate the requirement level. However, in response to stakeholder comments, EPA has again permitted STBs to fall under multiple Base Type definitions, but has clarified the requirement equations (Equation 1 and Equation 2) and Table 1, below, to ensure that the first applicable allowance from the top shall be claimed when qualifying a STB meeting multiple definitions.

Table 1: Base Type AEC Allowance (AEC_{BASE_MAX})

Base Type (Use Topmost if Multiple Apply)	Version 4.0 Allowance (kWh/year)
1. Cable DTA	35
2. Cable	55
3. Satellite	50
4. Service Provider Internet Protocol (IP)	45
5. Over-the-top (OTT) Internet Protocol (IP)	10
6. Terrestrial	18
7. Thin-client / Remote	15

Note: In developing the proposed levels, EPA used qualified product data. In some cases, EPA adjusted

these data to accommodate, for example, the changing test method under Version 4.1. To develop the proposed base allowances, EPA subtracted the additional functionality allowances that would be claimed under Version 4.1 from the estimated AEC to obtain the energy consumption that could be attributed to the base functionality of the STBs. In other words, AEC – $AEC_{ALLOWANCES}$ = AEC_{BASE}. EPA then set efficiency requirements such that the top performing base boxes would be eligible for the ENERGY STAR. The resulting base energy consumption amounts are shown above for the different types of STBs.

Further, EPA evaluated the base energy consumption of the STBs in each category against the additional functionality allowances they would likely claim (based on allowances claimed under Version 3.0) to ensure that higher-functionality STBs could continue to meet the revised allowance levels. EPA then adjusted base allowances and functional adders in combination such that the proposed requirements recognize top performers among those currently on the market, while more effectively taking into account higher-functionality boxes.

Additionally, EPA proposes the following changes:
Cable DTA: Per stakeholder comments that Cable DTA continue to ship, EPA has reinstated the base allowance for Cable DTAs to recognize the top performing models currently on the market and provide an alternative to higher energy consuming Cable STBs.
Thin-client/Remote: EPA has increased the allowance from Draft 1 to 15 kWh/yr. This base allowance is within reach of currently-qualified Thin-client STBs if they can Auto-power Down to 1.5 W, which EPA expects to be more common with MoCA 2.0.
Terrestrial: EPA understands that the market for Terrestrial STBs is limited and will be proposing to remove them from the scope under Version 5.0 of the specification.

3.3.3 Additional Functionality AEC Allowances (AEC_{ADDL_i}) shall be as specified in Table 2, subject to the following requirements:

i. No additional functionality allowances may be applied to STBs with CABLE DTA base functionality.

ii. The HOME NETWORK INTERFACE, and MIMO Wi-Fi HNI allowances are the only additional functionality allowances that may be applied to STBs with THIN CLIENT / REMOTE base functionality.

iii. The CableCARD allowance may only be applied once per STB, regardless of the number of CableCARDs installed in the STB.

iv. The DOCSIS allowance may only be applied to STBs that are installed in a Service Provider network with DOCSIS capability.

v. The MULTI-ROOM allowance may only be applied once per STB, regardless of the number of remote outputs served by the STB.

vi. The MULTI-ROOM allowance may only be applied to STBs that can provide live content and head-end interaction for Thin Client STBs.

Note: EPA has revised the definition of the multi-room adder to only apply to STBs that can provide live content and head-end interaction for Thin Client STBs. The adder will no longer apply to STBs that only serve as whole-home DVRs.

vii. The MULTI-ROOM allowance may not be combined with the HOME NETWORK INTERFACE allowance on a single STB.

viii. The MIMO Wi-Fi HNI allowance can only be combined with HOME NETWORK INTERFACE or MULTI-ROOM allowance and only when the device is tested with Wi-Fi as the HOME NETWORK INTERFACE providing the primary video transport for the device. It cannot be used at any other time and must be used in conjunction with the HOME NETWORK INTERFACE or MULTI-ROOM allowance.

Note: EPA has modified the instructions for applying the MIMI Wi-Fi HNI allowance, by limiting it to systems that are tested with the Wi-Fi "providing the primary video transport for the device."

ix. The MULTI-STREAM allowances may only be applied once per STB, regardless of the number of simultaneous streams supported by the STB.

x. The ROUTER and ACCESS POINT allowances may only be applied once per STB, and must be combined with the HOME NETWORK INTERFACE allowance.

Table 2: Additional Functionality AEC Allowance (AEC_{ADDL_i})

Additional Functionality	Version 4.0 Allowance (kWh/year)
CableCARD	15
Digital Video Recorder (DVR)	45
DOCSIS®	20
Home Network Interface (HNI)	10
MIMO Wi-Fi HNI	$2 \times N_{2.4\,\mathrm{GHz}} + 7 \times N_{5\,\mathrm{GHz}}$, Where: *N* is the number of spatial streams at the given frequency
Multi-room	56
Multi-stream – Cable/Satellite	16
Multi-stream – Terrestrial/IP	6
Router	27
Access Point	8
Telephony	4

Note: Although stakeholder comments and market data indicate that shipments of DOCSIS 3.0 equipment exceeded that of DOCSIS 2.0 by a factor of four in 2012 (IHS iSuppli), EPA will be retaining the Version 3.0 allowance for DOCSIS 2.0 (20 kWh). EPA believes this allowance to be adequate for DOCSIS 3.0 as well as: (1) DOCSIS 3.0, which supports multiple data channels, is typically used on multi-room STBs and is therefore better addressed through the Multi-room adder, and (2) there exist new ultra-wideband tuners that provide multiple channels at lower power.

Similarly, EPA proposes to retain the Version 3.0 allowance for HNI (10 kWh). Although stakeholders commented that MoCA requires additional power, the 10 kWh adder should cover the energy of MoCA 2.0 with power management enabled (0.5 watts in Standby) and 5 hours of active use.

Also, to permit the qualification of Displayless Video Gateways, which also provide home networking functionality, EPA has provided new adder allowances, based on the allowances in the Version 1.0 ENERGY STAR Small Networking Equipment specification, currently under development.

Similarly, to permit continuing qualification of highly-featured set-top boxes, EPA has increased the allowance for DVR, Multi-stream, and Multi-room functionality adders to permit whole-home energy savings.

Per stakeholder comment, EPA has also revised the MIMO Wi-Fi HNI adder for consistency with the Version 1.0 Small Network Equipment specification (note that the HNI adder provides an additional allowance that should be counted against the Small Network Equipment allowances below):

- Baseline Wi-Fi Allowance: 0.7 W (approx. 6 kWh/yr)
- 2.4 GHz (802.11n) allowance, per stream: 0.2 W (approx. 2 kWh/yr)
- 5 GHz (802.11ac) allowance, per stream: 1.3 W (approx. 11 kWh/yr)

Lastly, as announced in Draft 1, EPA proposes to eliminate allowances for Removable Media Player and Removable Media Players/Recorders and has therefore deleted the relevant allowances from Table 2.

3.3.4 Deep Sleep Incentive: For a power state to qualify as a Deep Sleep, and a model to receive the Deep Sleep Incentive in Equation 1 or Equation 2, measured power consumption in Deep Sleep State shall be less than or equal to 15% of the power consumption in On Mode (P_{WATCH}), or 3.0 watts, whichever is greater, and less than or equal to 95% of the power consumption in Sleep Mode (P_{SLEEP_MANUAL} or P_{SLEEP_APD}) as shown in Equation 3 for STBs and Equation 4 for Displayless Video Gateways, below, and subject to the following requirements.

Note: EPA has modified the Deep Sleep incentive in Draft 2 such that it applies only to Deep Sleep States separate from the Sleep Mode measured by the DOE NOPR to prevent allocation of double-incentives. Any savings obtained through a low-power Sleep Mode will already be reflected in the AEC. EPA has also included a further condition that the Deep Sleep State provide at least 5% savings over Sleep Mode such that the Deep Sleep State is a distinct mode, rather than simply another, less accessible way of entering Sleep Mode.

While maintaining a Deep Sleep incentive in Version 4.1, EPA anticipates that Version 5 will require Deep Sleep, based on stakeholder insights into the availability of products that enable Deep Sleep.

i. The Deep Sleep Incentive will be a factor of 17% applied to the measured AEC in Equation 1 or Equation 2.

ii. The Deep Sleep Incentive shall not be applied to Thin-Client/Remote STBs or Over-the-top IP STBs.

Note: EPA has limited the Deep Sleep Incentive such that it no longer applies to Thin-client/Remote STBs or Over-the-top IP STBs, which have already been demonstrated to reach low power levels, and therefore no longer require this incentive.

iii. A means of activating Deep Sleep shall be present and may include clearly marked button(s) or switch(es) on the remote control that shall begin activation of Deep Sleep within 2 seconds of being pressed and within two button presses. Alternatively, Deep Sleep shall be activated via a timer or network stimulus. Alternative button configurations or methods of reaching Deep Sleep will be acceptable with written approval from EPA.

Note: EPA has modified the above Deep Sleep State accessibility requirement by specifying that a product begin responding to a Deep Sleep request within 2 seconds of being commanded to do so (in case there are any shut-down actions that need to occur, or if the request was initiated accidentally and the request needs to be reversed). Furthermore, EPA has removed a front-panel switch or button from the list of available options as users are expected to rely on the remote control when controlling the STB.

Lastly, EPA has expanded the above requirement to include methods of activation formerly reserved for "set-back boxes" by permitting activation of Deep Sleep State through a timer or network command for all STBs.

iv. Deep Sleep functionality shall be enabled by default upon shipment to the end user.

v. Deep Sleep functionality shall not prevent a device from performing a user-scheduled DVR recording or other function.

vi. Conversely, a user-scheduled DVR recording or other function shall not prevent a device from entering and remaining in Deep Sleep, except during the time required to perform the

DVR recording or other function, and 15 minutes before and after the time required.

Note: EPA has added two additional requirements ensuring that Deep Sleep is compatible with user-scheduled recording and other functions to encourage the use of Deep Sleep.

vii. An override function may be provided to allow the end-user to disable Deep Sleep functionality.

Equation 3: Condition for Receiving the Deep Sleep State Incentive for STBs

$$P_{SLEEP\_SP} \leq \min\left[\max(0.15 \times P_{WATCH}, 3\text{ W}), 0.95 \times P_{SLEEP\_APD}, 0.95 \times P_{SLEEP\_MANUAL}\right],$$

Where:

- P_{SLEEP_APD} *is the Sleep Mode Power as measured in the Auto Power Down (APD) Test of the DOE test procedure;*
- P_{SLEEP_MANUAL} *is the Sleep Mode Power as measured in the Manual Sleep Test of the DOE test procedure;*
- P_{SLEEP_SP} *is the Power in any Deep Sleep State, as measured per Section 4.7; and*
- P_{WATCH} *is the On Mode Power as measured in the DOE test procedure.*

Equation 4: Condition for Receiving the Deep Sleep State Incentive for Displayless Video Gateways

$$P_{SLEEP\_SP} \leq \min[\max(0.15 \times P_{WATCH}, 3\text{ W}), 0.95 \times P_{SLEEP}]$$

Where:

- P_{SLEEP} *is the Sleep Mode Power as measured in Section 4.6.3i;*
- P_{SLEEP_SP} *is the Power in any Deep Sleep State, as measured per Section 4.7; and*
- P_{WATCH} *is the On Mode Power as measured in Section 4.6.4.*

3.3.5 Client Only Incentive: Multi-room STBs can receive an incentive for use in Equation 1 by going into a lower-power state while continuing to provide video to their connected clients, as calculated in Equation 5.

Equation 5: Calculation of Client Only Incentive for Multi-room STBs

$$Incentive_{CLIENT\_ONLY} = \frac{P_{MULTI\_STREAM} - P_{CLIENT\_ONLY}}{P_{MULTI\_STREAM}},$$

Where:

- $Incentive_{CLIENT\_ONLY}$ *is the Client Only Incentive applicable to Multi-room STBs;*
- P_{MULTI_STREAM} *is the On Mode Power as measured in the Multi-stream Test of the DOE test procedure; and*
- P_{CLIENT_ONLY} *is the On Mode Power as measured in Section 4.5.*

Note: Products intended for sale in the US market are subject to minimum toxicity requirements. Please see ENERGY STAR® Program Requirements for Set-top Boxes: Partner Commitments for details.

4 TESTING

4.1 Test Methods

4.1.1 Test methods identified in Table 3 shall be used to determine energy consumption.

Table 3: Test Methods for ENERGY STAR Qualification

Product Type	Test Method
STBs	Proposed DOE Test Procedure for Set-top Boxes contained in the Notice of Proposed Rulemaking published in the Federal Register on January 23, 2013. 78 FR 5076.
Displayless Video Gateways	Draft CEA-2043, Set-top Box (STB) Power Measurement, Rev, Apr-2013, subject to the clarifications in Section 4.6.

Note: DOE and EPA will be revising these requirements in the future once the DOE test procedure final rule is published and compliance is required. This ensures that both the ENERGY STAR and regulatory testing methodologies are aligned and allows manufacturers to utilize the same test data to meet both the Federal requirements and the ENERGY STAR program requirements.

4.1.2 Test methods identified in Table 4 shall be used to determine the eligibility of STBs and Displayless Video Gateways for additional incentives.

Table 4: Test Methods for Additional Incentives

Incentive	Test Method
Client Only Incentive for Multi-room STBs	Draft CEA-2043, Set-top Box (STB) Power Measurement, Rev, Apr-2013, subject to the clarifications in Section 4.5.
Deep Sleep Incentive for STBs and Displayless Video Gateways	Draft CEA-2043, Set-top Box (STB) Power Measurement, Rev, Apr-2013, subject to the clarifications in Section 4.7.

4.2 Number of Units Required for Testing

4.2.1 Units shall be selected for testing as follows:

i. For STBs (with the exception of STBs being tested for the client only incentive or the deep sleep incentive), units shall be selected for testing and results calculated according to the sampling requirements defined in 10 CFR Part 429, Subpart B § 429.55. The certified rating must be equal to or better than the ENERGY STAR specification requirements;

ii. For Displayless Video Gateways, a single unit of each Representative Model shall be selected for testing.

iii. For Multi-room STBs being tested for the Client Only Incentive, a single unit of each Representative Model shall be selected for testing.

iv. For STBs and Displayless Video Gateways being tested in a Deep Sleep State, a single unit of each Representative Model shall be selected for testing.

4.2.2 The measured performance of units tested and of each subsequent unit manufactured shall meet the ENERGY STAR eligibility criteria. Results of the tested units may be used to qualify additional individual model variations within a Basic Model, as defined in Section 1.

i. All models within a Basic Model must have the same certified rating per DOE's regulations in Part 429 and this rating must be used for all representations.

Note: As noted earlier, EPA and DOE are committed to harmonizing testing conducted for STBs, thus EPA will be revising these requirements on the DOE test procedure for STBs is finalized to minimize burden on manufacturers.

4.3 International Market Qualification

4.3.1 Products shall be tested for qualification at the relevant input voltage/frequency combination for each market in which they will be sold and promoted as ENERGY STAR, as specified in Table 5.

Table 5: Input Power Requirements

Market	Voltage	Voltage Tolerance	Maximum Total Harmonic Distortion	Frequency	Frequency Tolerance
North America, Taiwan	115 V ac	+/- 1.0 %	2.0%	60 Hz	+/- 1.0 %
Europe, Australia, New Zealand	230 V ac	+/- 1.0 %	2.0%	50 Hz	+/- 1.0 %
Japan	100 V ac	+/- 1.0 %	2.0%	50 Hz or 60 Hz	+/- 1.0 %

4.4 UUT Connection Precedence when Using Draft CEA-2043 for Displayless Gateway, Additional Multi-room STB Testing

i. STBs being tested per the DOE test procedure shall follow the connection precedence in the DOE test procedure.

ii. Otherwise, the UUT shall be connected to the first applicable input connection specified in Table 6.

Table 6: Input Connections

Connection (Protocol)
1. Coax (QAM/DOCSIS)
2. Coax (Satellite)
3. Wi-Fi
4. Ethernet
5. Other

iii. If the UUT is intended for operation on a Home Network or with Clients or Multi-room STBs and the input connection specified in Section 4.4ii, above, is insufficient to permit this operation, the UUT shall be further connected to the Home Network, Clients, or Multi-room STBs through a second connection specified in Table 7.

Table 7: Network Connections

Connection (Protocol)
1. Coax (MoCa)
2. Coax (HPNA)
3. Wi-Fi

4. Ethernet
5. HomePlug AV
6. Other

Note: The Input/Network table has been divided into two separate tables to clarify the testing of STBs operating over a Home Network or in a Multi-room configuration.

iv. If the UUT is a STB, it shall be connected to a Display Device with the first applicable Output connection specified in Table 8.

Table 8: Output Connections

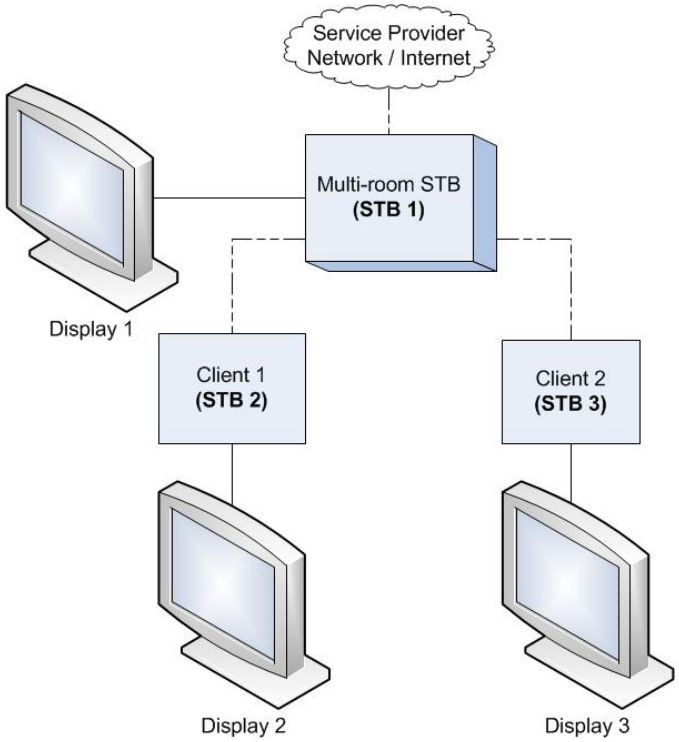
Connection (Protocol)
1. HDMI/DVI
2. Component
3. S-Video
4. Composite
5. Coax
6. Other

4.5 Implementation of Draft CEA-2043 for Additional Multi-room STB Testing

4.5.1 Multi-room STB Test Set-Up: Multi-room STBs shall be set up per Figure 1, using the connections specified in Section 4.4 and per the following requirements.

i. The Clients connected to the Multi-room STB shall be configured per draft CEA-2043.
ii. All other testing conditions shall be taken from the DOE test procedure as needed and if something is not specified there, from draft CEA-2043.

Figure 1: Multi-room STB Configuration[4]



4.5.2 Multi-room STB Test Conduct: Multi-room STBs may be tested to measure the Client Only Power, P_{CLIENT_ONLY}, and obtain the Client Only Incentive specified in Section 3.3.5, per the below requirements.

i. The devices in the configuration shall concurrently run all of the applicable draft CEA-2043 tests specified in the draft CEA-2043 (Rev. Apr-2013) section listed in Table 9, with the Thin Client/Remote STBs serving as a background condition for the testing of the Multi-room STB (UUT).

ii. The time period for Sleep Mode power consumption measurement (T_{SLEEP}) shall be equal to or greater than 4 hours.

iii. The wait time period for Sleep Mode power consumption measurement (T_{SLEEP_WAIT}) shall be less than or equal to 30 seconds.

4 This test configuration for measuring Client Only Power, P_{CLIENT_ONLY} may not be the same test configuration applicable for Multi-room STB tests specified under the DOE test procedure.

Table 9: Multi-room STB Client Only Test

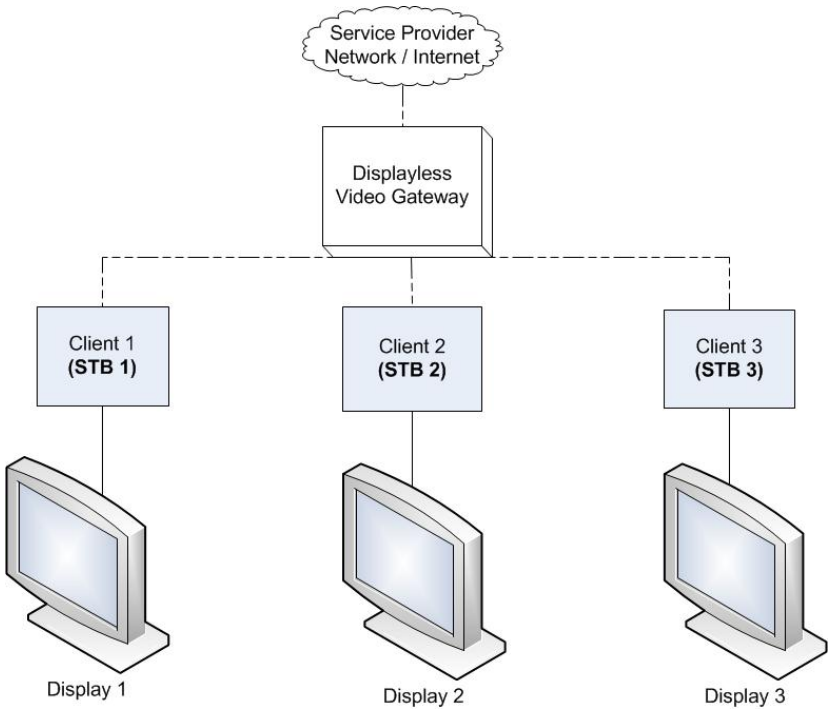
STB in Figure 1	Draft CEA-2043 Test	Result	Notes
STB 1 (UUT)	8.3 SLEEP*	P_{CLIENT_ONLY}	Multi-room STB not being used locally for viewing or recording
STB 2	8.2.2.2: ON (Play)	Not Measured	Thin Client in On Mode over a home network
STB 3	8.2.2.2: ON (Play)	Not Measured	Thin Client in On Mode over a home network

* NOTE: Although the UUT is being tested per the draft CEA-2043 Sleep Mode test and should start the test in that mode, the STB may actually change to a different Mode in order to provide video content to Clients, though the tester should do nothing to the UUT except switch the two Clients to On Mode.

4.6 Implementation of CEA-2043 for Displayless Video Gateway Testing

4.6.1 Displayless Video Gateway Test Set-Up: Displayless Video Gateways shall be set up per Figure 2, using the connections specified in Section 4.4, and subject to the requirements below.

Figure 2: Displayless Video Gateway Configuration



i. Displayless Video Gateways shall be configured per the setup in draft CEA-2043 (Rev. Apr-2013) for multi-room devices.

ii. The Clients connected to the Displayless Video Gateway shall be configured per draft CEA-2043.

iii. All other testing conditions shall be taken from the DOE test procedure as needed and if something is not specified there, from draft CEA-2043.

4.6.2 Displayless Video Gateway Voice and Data Setup:Unlike as specified in CEA 2043/DOE NOPR, the UUT shall be provisioned to provide data and/or voice services where applicable.

i. Voice: Displayless Video Gateways with Public Switched Telephone Network (PSTN) technology shall be configured and provisioned for VOIP services to allow incoming and outgoing calls. Connect an analog single-line telephone to the UUT via the RJ-14 jack on the unit using a 1.8 meter, 4 wire telephone extension with RJ-14 connectors.

ii. Data: Configure and provision data services such that there is a live, usable connection to the head end and a live, usable local area network via either MoCA, Ethernet, or Wi-Fi interfaces on the UUT, following the precedence list in Table 6 above. Follow the configuration directives in the ENERGY STAR Version 1.0 Small Network Equipment (SNE) Specification in Sections 6.3 through 6.4.7) of the SNE Test Procedure. Ignore the WAN portion of Section of 6.4.

iii. In the case of an Ethernet network, a switch capable of the same maximum link speed as the UUT shall be connected via a 1 meter Ethernet Cat 5a or Cat 6 cable.

iv. In the case of MoCA, a compatible MoCA bridge shall be connected via the appropriate COAX/Cat5e (or better) cable and provisioned for data services.

v. Additional devices shall not otherwise be connected to the local area network unless the connected Clients utilize this network for video transmission.

4.6.3 Displayless Video Gateway Sleep Mode Test Conduct: The following instructions describe the measurement of Sleep Mode for Displayless Video Gateways for the purposes of calculating AEC.

i. The Displayless Video Gateway under test and the connected Clients shall be running the CEA-2043 (Rev. Apr-2013) tests specified in Table 10 concurrently, with the Thin-client/Remote STBs serving as a background condition for the testing of the Displayless Video Gateway.

ii. When testing Sleep Mode for Displayless Video Gateways, no video traffic shall be sent to the Clients. Regardless of the internal state of the Displayless Video Gateway, this configuration shall be considered the Sleep Mode for the Displayless Video Gateway. Power values measured in this Sleep Mode shall be used for the purposes of calculating the AEC based on draft CEA-2043/DOE NOPR, in Section 4.6.5, below.

iii. The time period for Sleep Mode power consumption measurement (T_{SLEEP}) shall be equal to or greater than 4 hours.

iv. The wait time period for Sleep Mode power consumption measurement (T_{SLEEP_WAIT}) shall be less than or equal to 30 seconds.

Table 10: All Sleep Scenario 1

Device in Figure 2	CEA-2043 Test	Result	Notes
Displayless Video Gateway (UUT)	8.3.4 SLEEP	P_{SLEEP}	All Clients in SLEEP mode
STB 1	8.3.4 SLEEP	Not Measured	Thin Client/Remote STB in SLEEP mode over a home network
STB 2	8.3.4 SLEEP	Not Measured	Thin Client/Remote STB in SLEEP mode over a home network
STB 3	8.3.4 SLEEP	Not Measured	Thin Client/Remote STB in SLEEP mode over a home network

4.6.4 Displayless Video Gateway On Mode Test Conduct: The following instructions describe the measurement of Sleep Mode for Displayless Video Gateways for the purposes of calculating AEC.

i. The Displayless Video Gateway under test and the connected Clients shall be running the CEA-2043 (Rev. Apr-2013) tests specified in Table 11 concurrently, with the Thin Client/Remote STBs serving as a background condition for the testing of the Displayless Video Gateway.

ii. When testing On Mode for Displayless Video Gateways, video traffic shall be sent to all connected Clients. Regardless of the internal state of the Displayless Video Gateway, this configuration shall be considered the On Mode for the Displayless Video Gateway. Power values measured in this On Mode shall be used for the purposes of calculating the AEC based on draft CEA-2043/DOE NOPR, in Section 4.6.5, below.

iii. The time period for On Mode power consumption measurement (T_{ON}) shall be equal to or greater than 5 minutes.

Table 11: All On Scenario 2

Device in Figure 2	CEA-2043 Test	Result	Notes
Displayless Video Gateway (UUT)	8.2.2.1: ON (Watch)	P_{MULTI_STREAM}	All Clients in On Mode
STB 1	8.2.2.1: ON (Watch)	Not Measured	Watching TV on a Display Device connected to Thin Client/Remote STB over a home network
STB 2	8.2.2.1: ON (Watch)	Not Measured	Watching TV on a Display Device connected to Thin Client/Remote STB over a home network
STB 3	8.2.2.1: ON (Watch)	Not Measured	Watching TV on a Display Device connected to Thin Client/Remote STB over a home network

4.6.5 Calculation of AEC for Displayless Video Gateways: Calculate the AEC per Equation 6.

Equation 6: Calculation of Displayless Video Gateway AEC

$$AEC = 0.365 \times \left(P_{MULTI\_STREAM} \times H_{MULTI\_STREAM} + P_{SLEEP} \times [H_{SLEEP} + H_{APD}]\right),$$

Where:

- *AEC is the Displayless Video Gateway AEC;*
- *P_{MULTI_STREAM} is the On Mode Power as measured in the On Mode test, above;*
- *H_{MULTI_STREAM} is the number of hours assumed in On Mode, per Table 12;*
- *P_{SLEEP} is the Sleep Mode Power as measured in the Sleep Mode test, above;*
- *H_{SLEEP} is the number of hours assumed in Sleep Mode, per Table 12; and*
- *H_{APD} is the number of hours assumed in Automatic Power Down, as specified in Section 3.2.3, per Table 12.*

Table 12: Number of Hours Assigned to Each Displayless Video Gateway Mode of Operation

APD Enabled by Default	$H_{MULTI\ STREAM}$	H_{SLEEP}	H_{APD}
No	14	10	0
Yes	7	10	7

Note: EPA and DOE have clarified the instructions for testing Displayless Video Gateways by dividing them into separate subsections depending on mode. The specifics of the tests remain unchanged from Draft 1.

4.7 Implementation of CEA-2043 for STBs and Displayless Video Gateways with a Deep Sleep State

4.7.1 Deep Sleep State Test Setup: Units for test shall be set up per the following requirements.

i. All devices shall be configured per draft CEA-2043.

ii. The number of Clients, Display Devices, or Recording Devices connected to the UUT is unspecified; however, all devices shall be in Sleep Mode.

iii. All other testing conditions shall be taken from the DOE test procedure as needed and if something is not specified there, from draft CEA-2043.

4.7.2 User-enabled Deep Sleep State Test Conduct: STBs and Displayless Video Gateways with a user-enabled Deep Sleep State shall be tested per Section 8.3 of Draft CEA-2043 (Rev. Apr-2013), following the additional instructions in Section 8.3.3 of Draft CEA-2043 (Rev. Apr-2013) and per the following requirements.

i. The tester shall enable Deep Sleep State per manufacturer instructions and report the process for enabling Deep Sleep State.

Note: EPA and DOE have provided additional instructions for enabling and recording the process for Deep Sleep.

ii. The time period for Sleep Mode power consumption measurement (T_{SLEEP}) shall be equal to or greater than 4 hours.

iii. The wait time period for Sleep Mode power consumption measurement (T_{SLEEP_WAIT}) shall be less than or equal to 30 seconds.

iv. Any measurements of power in Deep Sleep State shall be used only to determine the Deep Sleep Incentive in Equation 3, and shall not be reported.

4.7.3 Scheduled Deep Sleep State Test Conduct: Perform only if scheduled sleep is enabled by default when the STB is shipped or installed.

i. All requirements in section 8.3.1 of CEA-2043 shall be followed.

ii. The time period for the test, $T_{SLEEP\_SCHEDULED}$, shall be equal to the duration of the default sleep schedule or 6 hours, whichever is smaller. If there is no default scheduled sleep time, then input the start and end time such that the total scheduled sleep duration ($T_{SLEEP\_SCHEDULED}$) is exactly 4 hours (e.g. scheduled sleep hours are set to be 1:00 am to 5:00 am).

iii. Within 30 minutes of the beginning of the scheduled sleep time, place the STB in the On (Watch TV) configuration.

iv. Begin power consumption measurement at the start of the scheduled sleep time and record the average power consumed as $P_{SLEEP\_SCHEDULED}$ over the time period $T_{SLEEP\_SCHEDULED}$.

Note: In response to stakeholder feedback, DOE and EPA worked together to develop a scheduled sleep test for the purposes of qualification of Deep Sleep. This test should be used to verify Deep Sleep State for those that wish to get the Deep Sleep credit outside of the AEC.

5 USER INTERFACE

5.1.1 Partners are encouraged to design products in accordance with the user interface standard IEEE P1621: 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 4.1 ENERGY STAR Set-top Box 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: EPA anticipates finishing the Version 4.1 specification this summer and will set an effective date closer to the completion date for this specification development effort.

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 qualification is not automatically granted for the life of a product model.

7 FUTURE SPECIFICATION REVISIONS

7.1.1 EPA intends to include the following topics in the next revision of the STB specification:

i. Implement a mandatory Deep Sleep requirement for all qualifying STBs.