



ENERGY STAR® Product Specification for Set-top Boxes

Eligibility Criteria Draft 2 Version 5.0

1 Following is the Version 5.0 ENERGY STAR product specification for Set-top Boxes (STBs). A product
2 shall meet all of the identified criteria to earn the ENERGY STAR.

3 1 DEFINITIONS

4 A) Set-top Box (STB): A device with the primary purpose of receiving digital television services from a
5 coaxial, hybrid fiber coaxial, or fiber-to-the-home distribution system, from satellites, or encapsulated
6 in IP packets from managed IP distribution networks; decrypting or descrambling these signals; and
7 decoding/decompressing for delivery to residential consumer displays and/or recording devices,
8 and/or one or more other Set-Top Boxes, including Thin Clients, in a residential multi-room
9 architecture. STBs which incorporate common LAN functionality as a secondary function are
10 considered STBs for this specification.

11 **Note:** EPA is proposing to redefine Displayless Video Gateway (DVG) such that it is considered a type of
12 Non-Thin Client STB per the diagram below. The proposed definition, above, is based on the Voluntary
13 Agreement for Ongoing Improvement to the Energy Efficiency of Set-top Boxes (VA) and is consistent
14 with this shift in nomenclature.

15
16 Because of the above definition’s references to STB decoding and decrypting functions, EPA expects this
17 definition to unambiguously cover DVGs but not products that fall within the scope of the ENERGY STAR
18 specification for Small Network Equipment, such as integrated access devices (IADs). However, EPA
19 welcomes feedback on this proposal, in particular, on any uncertainty in classifying MVPD IP STBs and
20 gateways. For example, EPA seeks comment whether the MVPD IP STBs have a “Direct Service
21 Provider Source Input?” per the figure below.
22

		Primary purpose is receiving television services?		
		Yes		No
		Local Video Connection?		
		Yes	No	Small Network Equipment (covered in separate ENERGY STAR Specification)
Direct Service Provider or Streaming Video Provider Source Input?	Yes	Non- Thin Client STB		
	No	Thin Client/ Remote STB	Excluded from Scope	

23
24 B) Product Type (Base Type): The means of access to video content for a STB.

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

- 28 2) Satellite: A STB that can receive and decode video content as delivered from a MVPD satellite
29 network.
- 30 3) Cable Digital Transport Adapter (DTA): A minimally-configured Cable STB that can receive
31 television signals from a broadband, hybrid fiber/coaxial, or community cable distribution system.
- 32 4) Internet Protocol (IP): A STB that can receive television/video signals encapsulated in IP packets.
- 33 i) Over-the-top (OTT) Internet Protocol (IP): An IP STB that cannot receive signals from a
34 Multichannel Video Programming Distributor (MVPD) as defined in Title 47 U.S. Code § 522.
- 35 ii) Multichannel Video Programming Distributor (MVPD) Internet Protocol (IP): An IP STB that
36 can receive signals from a MVPD.
- 37 5) Thin-client / Remote: A STB that can receive content over an HNI from another STB, but is
38 unable to interface directly to the MVPD network.
- 39 C) Additional Functionality:
- 40 1) CableCARD: The capability to decrypt premium audio/video content and services and provide
41 other network control functions via a plug-in Conditional Access module that complies with the
42 ANSI/SCTE 28 HOST-POD Interface Standard¹.
- 43 2) Digital Video Recorder (DVR): A feature that records television signals on a hard disk drive (HDD)
44 or other non-volatile storage device integrated into the STB for playback at an arbitrary time. A
45 DVR includes features such as: Play, Record, Pause, Fast Forward (FF), and Fast Rewind (FR).
46 STBs that only support buffering or a Service Provider network-based "DVR" service are not
47 considered DVR STBs for purposes of this specification. The presence of DVR functionality does
48 not mean the device is defined to be a STB.
- 49 3) DOCSIS®: The capability to distribute data and audio/video content over cable television
50 infrastructure in accordance with the CableLabs® Data Over Cable Service Interface
51 Specification².
- 52 4) Home Network Interface (HNI): An interface with external devices over a local area network
53 (example: Institute of Electrical and Electronics Engineers (IEEE) 802.11 (Wireless-Fidelity or Wi-
54 Fi), Multimedia over Coax Alliance (MoCA), HomePNA alliance (HPNA), IEEE 802.3, HomePlug
55 AV) that is capable of transmitting video content.
- 56 i) Multi-Input Multi-Output (MIMO) Wireless HNI: IEEE 802.11n/ac and related MIMO enabled
57 Wi-Fi functionality that supports more than one spatial stream in both send and receive.
58 When using the notation MIMO AxB: A is considered the number of spatial streams while B is
59 the number of antennas supported. A spatial stream is an independent and separately
60 encoded data signal.
- 61 5) Multi-room: The capability to provide independent live audio/video content to two or more Clients
62 or support pause/time-shifting capability for otherwise standalone IP or Thin-client STBs within a
63 single family living unit. This definition does not include the capability to manage gateway
64 services for multi-subscriber scenarios.
- 65 6) Multi-stream: A STB feature that allows the device to receive multiple independent streams of
66 video content for use with one or more Clients, one or more directly connected Display Devices,
67 or a DVR, picture-in-picture, etc. This definition does not include the capability to manage
68 gateway services for multi-subscriber scenarios.
- 69 7) Ultra HD (4k) Resolution: The capability to transmit or display video signals with a minimum
70 output resolution of 3840x2160 pixels in progressive scan mode at minimum frame rate of 24 fps
71 (abbreviated 2160p24).

1 <http://www.scte.org/standards/>

2 <http://www.cablelabs.com/specs/>

- 72 8) High Efficiency Video Processing: Video decoding providing compression efficiency significantly
73 higher than H.264/AVC, for example HEVC (H.265).
- 74 9) Three-dimensional (3D) Capability: The capability to transmit or display video signals with 3D
75 depth information for stereoscopic display.
- 76 10) Access Point: The capability to provide wireless network connectivity to multiple clients. For the
77 purposes of this specification, Access Point functionality includes only IEEE 802.11 (Wi-Fi)
78 connectivity.
- 79 11) Router: The capability to determine the optimal path along which network traffic should be
80 forwarded. Routers forward packets from one network to another based on network layer
81 information. Router functionality includes Access Point functionality.
- 82 12) Telephony: The ability to support analog telephones through one or more RJ11 or RJ14 jacks.
- 83 13) Transcoding: Additional capability to translate (e.g., MPEG2 to H.264), transrate (e.g., HD bitrate
84 to Mobile bitrate), transscale (e.g., HD resolution to Mobile resolution), transcode (e.g., CAS to
85 DRM), or perform audio format conversions (e.g., AC-3 to AAC) in real-time.
- 86 D) Auto Power Down (APD): A STB feature that monitors parameters correlated with the user activity or
87 viewing. If the parameters collectively indicate that no user activity or viewing is occurring, the APD
88 feature enables the STB to transition to Sleep Mode.
- 89 E) Principal Function: Functions necessary for selecting (via electronic program guide), receiving,
90 decoding, decompressing, or delivering live or recorded audio/video content to a Display Device,
91 local/remote recording device, or Client. Monitoring for user or network requests is not considered a
92 Principal Function for STBs.
- 93 F) Operational Modes:
- 94 1) On Mode: The STB is connected to a power source. At least one Principal Function is activated
95 and all Principal Functions are provisioned for use. The power draw in On Mode may vary based
96 on specific use and configuration.
- 97 2) Sleep Mode: A range of reduced power states where the STB is connected to a power source
98 and is not providing any Principal Function. The STB may transition to On Mode due to user
99 action, internal signal, or external signal. The power drawn in this mode may vary based on
100 specific use or configuration. If any Principal Function is activated while operating in this mode,
101 the STB is assumed to transition to On Mode. Monitoring for user or network requests is not
102 considered a Principal Function. The STB shall be able to transition from this mode to On Mode
103 within 30 seconds to be considered in Sleep Mode.
- 104 i) Deep Sleep State: A power state within Sleep Mode characterized by power draw less than
105 or equal to 1 W.
- 106 3) Scheduled Sleep Mode: A power state characterized by power draw that provides additional
107 energy savings beyond that offered by Sleep Mode, delivered through a schedule or special
108 button press, and requiring a transition time to On Mode greater than 30 seconds.

109 **Note:** Due to concerns with usability and savings offered by the previously defined Deep Sleep State,
110 EPA is redefining this term to be a state within Sleep Mode (i.e., latency less than 30 seconds, no
111 required schedule) that offers significant savings. Later in the specification, EPA has revised the TEC
112 requirements for Thin Clients and OTT IP STBs such that Deep Sleep State, or another mechanism that
113 achieves similar reductions, would need to be deployed by 2018.

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115 The state formerly known as Deep Sleep has been renamed to “Scheduled Sleep” and is incentivized
116 through changes to the TEC weighting, as in Version 4.1. EPA welcomes feedback on this proposal.
117 Upon finalization of Version 5.0, Service Providers will have access to the Deep Sleep incentive when
118 deploying Thin Clients and OTT IP boxes that offer Deep Sleep. Effective January 1, 2018, Service
119 Provider incentives for Deep Sleep will apply only to boxes other than Thin Clients and OTT IP STBs.
120 Service Providers may also secure an incentive when purchasing non-Thin Client boxes that make use of

121 | Scheduled Sleep.

122 G) Other Definitions

- 123 1) Display Device (DD): A device (e.g., TV, Computer Monitor, or Portable TV) that receives its
124 content directly from a STB through a video interface (example: High-Definition Multimedia
125 Interface (HDMI), Component Video, Composite Video, or S-Video), not through a HNI, and
126 displays it for viewing.
- 127 2) Client: A device (e.g., STB, Thin-Client STB, Smart TV, Mobile Phone, Tablet, PC, etc.) that can
128 receive content over a HNI from another STB.
- 129 3) External Power Supply (EPS): Also referred to as External Power Adapter. An external power
130 supply circuit that is used to convert household electric current into dc current or lower-voltage ac
131 current to operate a consumer product.
- 132 4) Standard dc: A method for transmitting dc power defined by a well-known technology standard,
133 enabling plug-and-play interoperability.
- 134 Note: Common examples are Universal Serial Bus (USB) and Mobile High-definition Link (MHL).
135 Usually Standard dc includes both power and communications over the same cable but that is
136 not required.
- 137 5) Service Provider: A business entity that provides video content, a delivery network, and
138 associated installation or support services to subscribers with whom it has an ongoing contractual
139 relationship.

140 **Note:** In response to stakeholder comment, EPA evaluated fully shifting the focus of this program to
141 service providers, assigning them responsibility for certifying and maintaining responsibility for verification
142 of all ENERGY STAR STBs. As the program is currently structured, service providers are already
143 permitted to play this role, and one service provider partner does so, partnering with EPA as a
144 manufacturer and service provider.

145
146 EPA has concluded that a full shift to a service provider focus has negative implications at present as it
147 would significantly reduce the incentive manufacturers have to design and make available the most
148 efficient of STBs for a prospective service provider customer or one that has not yet become and
149 ENERGY STAR partner. Further, taking this approach now may also negatively impact small service
150 provider partners that may not be testing STBs on their own networks at present under the VA. EPA
151 believes that taking this approach may be viable in the future when a greater percentage of service
152 providers become partners and smaller providers have access to more testing infrastructure.

- 153 6) Multichannel Video Program Distributors (MVPD): An organization such as a cable operator, a
154 multichannel multipoint distribution service, a direct broadcast satellite service, or a television
155 receive-only satellite program distributor, who makes available for purchase, by subscribers or
156 customers, multiple channels of video programming. This FCC definition does not currently
157 include OTT service providers.
- 158 7) Conditional Access: The encryption, decryption, and authorization techniques employed to
159 protect content from unauthorized viewing. CableCARD and Downloadable Conditional Access
160 System (DCAS) are examples of Conditional Access technology.
- 161 8) Typical Energy Consumption (TEC): A means for evaluating energy efficiency through a
162 calculation of expected energy consumption for a typical household over a one year period,
163 expressed in units of kWh/year.
- 164 9) Unit Under Test (UUT): The STB being tested.
- 165 H) Product Family: A group of product models that are (1) made by the same manufacturer, (2) subject
166 to the same ENERGY STAR certification criteria, and (3) of a common basic design. Product models
167 within a family differ from each other according to one or more characteristics or features that either
168 (1) have no impact on product performance with regard to ENERGY STAR qualification criteria, or (2)

169 are specified herein as acceptable variations within a product family. For Set-top Boxes, acceptable
170 variations within a product family include:

- 171 1) Aesthetic housing changes that do not affect the thermal characteristics of the device (e.g., color,
172 labeling, or other cosmetic modifications); and
- 173 2) Software configuration.

174 **2 SCOPE**

175 **2.1 Included Products**

176 2.1.1 Products that meet the definition of Set-top Box and a Set-top Box Base Type as specified herein
177 are eligible for ENERGY STAR certification, with the exception of products listed in Section 2.2.

178 **2.2 Excluded Products**

179 2.2.1 Products that are covered under existing ENERGY STAR product specifications are not eligible
180 for qualification under the STB specification. The list of specifications currently in effect can be
181 found at www.energystar.gov/specifications.

182 **3 QUALIFICATION CRITERIA**

183 **3.1 Significant Digits and Rounding**

184 3.1.1 All calculations shall be carried out with directly measured (unrounded) values.

185 3.1.2 Unless otherwise specified, compliance with specification limits shall be evaluated using directly
186 measured or calculated values without any benefit from rounding.

187 3.1.3 Directly measured or calculated values that are submitted for reporting on the ENERGY STAR
188 website shall be rounded to the nearest significant digit as expressed in the corresponding
189 specification limit.

190 **3.2 General Qualification Criteria**

191 3.2.1 External Power Supply (EPS): Single- and Multiple-voltage EPSs shall meet the Level VI or
192 higher performance requirements under the International Efficiency Marking Protocol when tested
193 according to the Uniform Test Method for Measuring the Energy Consumption of External Power
194 Supplies, Appendix Z to 10 CFR Part 430.

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

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

198 3.2.2 Maintenance Activities:

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

206 ii. Products that have exited Sleep Mode or Deep Sleep State and completed maintenance or

207 other user-requested activities shall automatically return to Sleep Mode or Deep Sleep State
208 in less than 15 minutes.

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

212 3.2.3 Auto Power Down (APD): To apply “YES” in Table 1 Operational Mode Durations for Column 1
213 “APD Enabled by Default,” products shall meet the following requirements:

214 i. STBs shall be deployed with APD enabled by default, with APD timing set to engage after a
215 period of less than or equal to 4 hours from last user activity. User activity is defined as any
216 activity in which the user interacted with the UUT. The Emergency Alert System (EAS)
217 system can wake the box and should also be considered user activity for the purposes of this
218 requirement.

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

221 **Note:** EPA simplified the APD and Scheduled Sleep Mode (formerly Deep Sleep) requirements to require
222 certain behavior of STBs once deployed. Previously the requirements applied to both manufacturer-
223 provided software as well as the initial software download/update from the Service Provider. EPA
224 welcomes feedback on this simplification to the APD and Scheduled Sleep Mode requirements.

225 3.2.4 Scheduled Sleep Mode: To apply “YES” in Table 1 Operational Mode Durations for Column 2
226 “Automatic Scheduled Sleep,” products shall meet the following requirements:

227 i. STBs shall be deployed with Scheduled Sleep enabled by default.

228 ii. A means of activating Scheduled Sleep shall be present and may include clearly marked
229 button(s) or switch(es) on the remote control that shall begin activation of Scheduled Sleep
230 within 2 seconds of being pressed and within two button presses. Additionally, Scheduled
231 Sleep shall be activated via a user-controllable timer or network stimulus. Alternative button
232 configurations or methods of reaching Scheduled Sleep will be acceptable with written
233 approval from EPA.

234 iii. Scheduled Sleep functionality shall not prevent a device from performing a user-scheduled
235 DVR recording or other function.

236 iv. Conversely, a user-scheduled DVR recording or other function shall not prevent a device
237 from entering and remaining in Scheduled Sleep, except during the time required to perform
238 the DVR recording or other function, and 15 minutes before and after the time required.

239 v. An override function may be provided to allow the end-user to disable Scheduled Sleep
240 functionality; however, users shall first be offered an explanation of the Scheduled Sleep
241 feature and provided the opportunity to change the schedule to better suit their needs.

242 vi. After the end of Scheduled Sleep time, the STB must resume Sleep Mode functionality
243 including the ability to transition to On Mode in 30 seconds or less.

244 **Note:** EPA seeks feedback on current and forthcoming approaches to Scheduled Sleep and ways to
245 simplify and update these requirements to align with the market.

246 3.3 Typical Energy Consumption (TEC) Requirements

247 3.3.1 TEC as determined per the test procedure, multiplied by a factor relating to the client-only
248 incentive, shall be less than or equal to the Maximum TEC Specification Requirement (TEC_{MAX}),
249 as illustrated in Equation 1.

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Equation 1: TEC Requirement for STBs

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$$(1 - Incentive_{CLIENT_ONLY}) \times TEC \div eff_{ac-dc} \leq TEC_{MAX} = TEC_{BASE} + \sum_1^n TEC_{ADDL_i}$$

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Where:

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- *TEC* is the Typical Energy Consumption, as calculated in Equation 2;

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- *Incentive_{CLIENT_ONLY}* is an incentive for Multi-room STBs, as specified in Section 3.3.3, with a local display;

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- *eff_{ac-dc}* is the standard adjustment for ac-dc power conversion losses that occur at the device powering the STB, and is 1.0 for Ac-powered STBs and 0.85 for STBs with Standard dc;

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- *TEC_{MAX}* is the maximum TEC Specification Requirement—the level for ENERGY STAR certification;

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- *TEC_{BASE}* is the topmost applicable Base Type TEC Allowance (kWh), as specified in Table 2; and

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- *TEC_{ADDL_i}* is each applicable Additional Functionality TEC Allowance (kWh), as specified in Table 3, applied once per functionality and subject to the requirements in Section 3.3.2, below.

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Note: Since EPA is proposing to redefine Displayless Video Gateway (DVG) to be a type of STB as opposed to a separate product class, the Agency has clarified that the Client-only Incentive only applies to Multi-room STBs with a local display (i.e., non-DVGs). EPA has also removed the DVG-specific requirements formerly located in the section below.

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Also, EPA has received feedback that Multi-room STBs already decrease energy consumption when transmitting content to clients rather than the display, such that the incentive may not be necessary. EPA welcomes further feedback on this topic.

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Equation 2: TEC Calculation

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$$TEC = 0.365 \left[(T_{WATCH_TV} \times P_{WATCH_TV}) + (T_{SLEEP} \times P_{SLEEP}) + (T_{APD} \times P_{APD_ON_to_SLEEP}) + (T_{SCHED_SLEEP} \times P_{SLEEP_SP_2}) \right]$$

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Where:

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- *T_{WATCH_TV}* is the time coefficient for On Mode, as determined per Table 1

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- *P_{WATCH_TV}* is the measured power in On Mode (W);

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- *T_{SLEEP}* is the time coefficient for Sleep Mode, as determined per Table 1;

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- *P_{SLEEP}* is the measured power in Sleep Mode, including Deep Sleep (W);

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- *T_{APD}* is the time coefficient for APD, as determined per Table 1;

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- *P_{APD_ON_to_SLEEP}* is the measured power after an APD timeout (W);

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- *T_{SCHED_SLEEP}* is the time operating in Scheduled Sleep Mode (maximum of 4h); and

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- *P_{SLEEP_SP_2}* is the measured power in an automatic Scheduled Sleep Mode (W).

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Table 1: Operational Mode Durations

Sleep Mode APD Enabled by Default*	Automatic Scheduled Sleep	<i>T_{WATCH_TV}</i>	<i>T_{SLEEP}</i>	<i>T_{APD}</i>	<i>T_{SCHED_SLEEP}</i>
NO	NO	14	10	0	0
NO	YES	14	10 – <i>T_{SCHEDULED_SLEEP}</i>	0	Scheduled Sleep as

Sleep Mode APD Enabled by Default*	Automatic Scheduled Sleep	T_{WATCH_TV}	T_{SLEEP}	T_{APD}	T_{SCHED_SLEEP}
					deployed duration (requires APD to scheduled sleep)
YES	NO	$7 - \frac{4 - T_{APD\ ON\ to\ SLEEP}}{2}$	10	$7 + \frac{4 - T_{APD\ ON\ to\ SLEEP}}{2}$	0
YES	YES	$7 - \frac{4 - T_{APD\ ON\ to\ SLEEP}}{2}$	$10 - T_{SCHEDULED\ SLEEP}$	$7 + \frac{4 - T_{APD\ ON\ to\ SLEEP}}{2}$	Scheduled Sleep as-deployed duration (requires APD to Scheduled Sleep)

* APD to include APD to Deep Sleep.

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Table 2: Base Type TEC Allowance (TEC_{BASE_MAX})

Base Type (Use Topmost if Multiple Apply)	Allowance (kWh/year)
1. Cable DTA	37
2. Cable	50
3. Satellite	50
4. Multichannel Video Programming Distributor (MVPD) Internet Protocol (IP)	40
5. Thin-client / Remote	7 (Applicable after January 1, 2018)
6. Terrestrial	
7. Over the top (OTT) Internet Protocol (IP)	7

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Note: Based on additional information and data EPA has applied to its dataset since release of Draft 1 and the additional analysis the Agency has completed, EPA is proposing revised allowances for the Cable, CableDTA, Satellite, and MVPD IP STBs. The base allowances for Cable and Satellite STBs are equal to reflect the fundamental similarities between these two types of products, with any front-end differences (CableCARD, DOCSIS) addressed, in part, through adder allowances. The MVPD IP base allowance is less than the Cable and Satellite base allowances to reflect the absence of tuners in this type of STB. Finally, with these base allowances, EPA believes it has achieved a balance between continuing to recognize the leading products in each category while also permitting a selection of simple and complex STBs to earn the ENERGY STAR. EPA welcomes feedback on the proposed base allowances.

Seeing Thin Clients achieve Deep Sleep is the priority for this product type for Version 5.0. As such, EPA has proposed a level based on a low-latency Deep Sleep State, in which STBs without a MVPD connection can draw 1 W or less when not in use, consistent with other consumer products and some OTT STBs. EPA recognizes that this capability is not available in current STBs and has, therefore,

311 proposed to delay the effective date of Version 5.0 for Thin Clients until January 1, 2018. Until that time,
312 EPA will retain the Version 4.1 specification (including a base level of 30kWh/year) for Thin Clients. In
313 doing so, EPA intends to reduce partners' certification responsibilities.

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315 EPA has revised the definition of Deep Sleep to reflect that it is intended to be indistinguishable by the
316 consumer from Sleep to make it easy to use.

317 Additional Functionality TEC Allowances (TEC_{ADDL_i}) shall be as specified in Table 3, subject to
318 the following requirements:

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

321 ii. The HOME NETWORK INTERFACE, MIMO Wi-Fi HNI, MULTI-STREAM, Ultra HD
322 Resolution, and HEVP-TC allowances are the only additional functionality allowances that
323 may be applied to STBs with THIN CLIENT / REMOTE base functionality.

324 **Note:** EPA is proposing to allow Thin Clients to claim the Multi-stream allowance, as stakeholders have
325 noted that Thin Clients may be offering picture-in-picture functionality in the near future.

326 iii. The CableCARD allowance may not be applied more than twice per STB.

327 iv. The DOCSIS 2 and DOCSIS 3.X allowances may only be applied to STBs that are installed
328 in a Service Provider network with DOCSIS capability.

329 **Note:** EPA is proposing to restore the DOCSIS 2 allowance as there are a number of STBs that continue
330 to use this feature, and providing an allowance for it better reflects the distribution of energy consumption
331 between the base and additional functionalities.

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333 EPA also wishes to clarify that the previously-proposed DOCSIS 3 allowance applies to both DOCSIS 3.0
334 and the forthcoming DOCSIS 3.1, and has therefore renamed it to DOCSIS 3.X. EPA has received
335 feedback that the tests of early products incorporating DOCSIS 3.1 indicate that the current allowance
336 may be insufficient for the increased energy consumption of the updated protocol; however, EPA is
337 proposing the current level and encourages manufacturers to identify innovative solutions to meeting it.
338 Further discussions on this issue can be incorporated into a potential Version 5.1 minor specification
339 revision.

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341 v. Either the DOCSIS 2 or the DOCSIS 3.X allowance may be applied, but not both.

342 **Note:** One stakeholder noted that DOCSIS 3.0 models are backwards-compatible with DOCSIS 2, which
343 would imply that providing DOCSIS 2 capability in addition to DOCSIS 3.0 should not require any more
344 energy. Therefore, EPA is proposing that models can only claim either the DOCSIS 2 or the DOCSIS 3.X
345 allowance, but not both.

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

349 vii. The MULTI-ROOM allowance may only be applied to STBs that can provide live audio/video
350 content to multiple devices (2 or more Clients) or support pause/time-shifting capability for
351 otherwise standalone IP or Thin-client STBs.

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

354 ix. The MIMO Wi-Fi HNI allowance can only be combined with HOME NETWORK INTERFACE
355 or MULTI-ROOM allowance and only when the device is tested with Wi-Fi as the HOME
356 NETWORK INTERFACE providing the primary video transport from the MULTI-ROOM STB
357 to the device. It cannot be used at any other time and must be used in conjunction with the
358 HOME NETWORK INTERFACE or MULTI-ROOM allowance.

- 359 x. The MULTI-STREAM allowances may only be applied once per STB, regardless of the
360 number of simultaneous streams supported by the STB.
- 361 xi. Either the ROUTER or ACCESS POINT allowance may be applied once per STB, and must
362 be combined with the HOME NETWORK INTERFACE or MULTI-ROOM allowance.
- 363 xii. The HEVP and HEVP-TC allowances may only be applied to STBs that provide an UltraHD
364 output through decoding an UltraHD stream or upscaling an HD stream per the Test Method.
365 They may not be applied to STBs without a local display.

366 **Note:** Again, since EPA is proposing to combine STBs and DVGs under the definition of STB, the Agency
367 has clarified that the above allowances do not apply to STBs without a local display (i.e., former DVGs).
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369 **Table 3: Additional Functionality TEC Allowance (TEC_{ADDL_i})**

Additional Functionality	Allowance (kWh/year)
Advanced Video Processing	0
Advanced Video Processing – Additional	0
CableCARD	15
CableCARD – Max One Additional	15
Digital Video Recorder (DVR)	35
DOCSIS® 2	25
DOCSIS® 3.X	45
HD	0
High Efficiency Video Processing (HEVP)	10
High Efficiency Video Processing for Thin Clients (HEVP-TC)	10
Home Network Interface (HNI)	15
MIMO Wi-Fi HNI (MIMO) 802.11n Low Power (< 200 mW conducted output power) Base (Initial 2x2 Streams)	9
MIMO 802.11ac Low Power Base (initial 2x2 Streams)	18
MIMO Wi-Fi Low Power Additional Streams Beyond 2x2	3
MIMO 802.11n High Power (>= 200 mW conducted output power) Base (Initial 2x2 Streams)	11
MIMO 802.11ac High Power Base (initial 2x2 Streams)	22
MIMO Wi-Fi High Power Additional Streams Beyond 2x2	4
Multi-room	21
Multi-stream – Cable/Satellite	18
Multi-stream –IP	18
Multi-stream – Additional	0
Transcoding	13

Additional Functionality	Allowance (kWh/year)
Transcoding – Each Additional	5
UltraHD Resolution	5
Access Point	8
Router	15
Telephony	4

370

371 **Note:** EPA is proposing updated allowances for several additional functionalities based on an updated
372 dataset of 62 ENERGY STAR models and 79 VA models as well as data corrections and additional
373 feedback received from stakeholders. As before, the adder allowances were evaluated through
374 multivariate regressions, with one added step. For allowances on which EPA received no substantive
375 comment or which EPA is proposing to base on the VA, the U.S. Small Network Equipment Voluntary
376 Agreement (SNE VA), or other proposals, their values were first subtracted from the energy consumption
377 of models featuring those adders. After this step, the regression analysis focused on the adders where
378 EPA could use test data to develop an updated allowance, specifically for: CableCARD, DVR, HNI, Multi-
379 room, and Multi-stream.

380

381 As noted above, the first step involved setting some of the adder allowances to pre-determined values
382 based on the STB or SNE VA, the previously-proposed Draft 1, or stakeholder suggestions, as follows:
383

384

385 **DOCSIS 2 and DOCSIS 3.X:** Following stakeholder feedback that STBs continue to use DOCSIS and
386 that the proposed allowance for DOCSIS 3 was too low for even the 1x1 energy-saving mode, EPA is
387 proposing to reinstate allowances based on the VA. The VA provides 20 kWh for DOCSIS 2 and 50 kWh
388 for DOCSIS 3; however, after applying these allowances combined with the others in Table 2 and Table
389 3, EPA noticed that many more DOCSIS 3 models were meeting compared to DOCSIS 2, even though
390 DOCSIS 2 models consumed less energy as a whole. As a result, EPA decreased the DOCSIS 3
391 allowance, while correspondingly increasing the DOCSIS 2 allowance to match the pass rates between
392 the two, resulting in a DOCSIS 2 allowance of 25 kWh/yr and DOCSIS 3.X allowance of 45 kWh.

393

394 **HEVP and HEVP-TC:** In comments on Draft 1, one stakeholder noted that the allowance for HEVP was
395 too large while that for HEVP-TC was too small and should be revised. These allowances were
396 developed in Version 4.1 before the wide applicability of products supporting these features, with the
397 expectation that the implementation of HEVP on Thin Clients would require less energy due to more
398 efficient components used in the generally more efficient Thin Clients, the use of power management
399 (Deep Sleep), and the lack of support for multiple streams. In response to stakeholder feedback, EPA is
400 now proposing to provide parity between the HEVP and HEVP-TC allowances, and reflect the other
401 differences in the base allowances or the Multi-stream allowance. Both the HEVP and HEVP-TC
402 allowances are proposed at 10 kWh/yr.

403

404 **MIMO HNI:** After reviewing stakeholder feedback, EPA is proposing to harmonize the structure and
405 allowances for MIMO with the SNE VA, which provides an allowance for a base capability of 2 streams
406 (2x2), depending on the protocol used (802.11n or 802.11ac—lower or higher data rate) and conducted
407 output power. Additional allowances are provided for streams beyond the initial 2 and vary depending on
408 conducted output power. The allowances in the SNE VA are expressed in watts and have been converted
409 into kWh assuming continuous operation (8760 hours per year), as follows:

410

- 410 • MIMO Wi-Fi HNI (MIMO) 802.11n Low Power (< 200 mW conducted output power) Base (Initial 2x2
411 Streams): 1 W ≈ 9 kWh

411

- 411 • MIMO 802.11ac Low Power Base (initial 2x2 Streams): 2.1 W ≈ 18 kWh

412

- 412 • MIMO 802.11ac Low Power Additional Streams Beyond 2x2 MIMO Wi-Fi HNI: 0.3 W ≈ 3 kWh

413

- 413 • MIMO 802.11n High Power (≥ 200 mW conducted output power) Base (Initial 2x2 Streams): 1.2 W ≈
414 11 kWh

414

- 415
- MIMO 802.11ac High Power Base (initial 2x2 Streams): 2.5 W ≈ 22 kWh
 - MIMO High Power Additional Streams Beyond 2x2 MIMO Wi-Fi HNI: 0.4 W ≈ 4 kWh.
- 416
- 417

418 EPA acknowledges that the SNE allowances in watts were based on Idle Mode power consumption;
419 however, tests of current network equipment reveal less than 0.5 W difference in power between Idle and
420 On Mode (medium data rate) for most models. Furthermore, while the SNE VA is intended to reflect the
421 performance achievable by all models, the ENERGY STAR is a leadership mark. Therefore, STB models
422 meeting ENERGY STAR can be expected to feature innovative designs that incorporate cutting edge
423 components that inherently perform better than those in SNE models meeting SNE VA requirements, and
424 should be able to meet these requirements even while transmitting or receiving video streams. EPA
425 welcomes feedback on this proposal.

426

427 **Access Point, Router, Telephony:** No STBs in the dataset supported these features, so the allowance
428 values for these did not affect the analysis in any way. Nonetheless, EPA is continuing to expect gateway
429 STBs with this functionality to emerge. Based on a review of stakeholder feedback and the SNE VA, EPA
430 is proposing to increase the allowances to 8 kWh/yr for Access Point and 15 kWh/yr for Router. As noted,
431 a product cannot claim both the Router and Access Point allowance. EPA is not proposing any changes
432 to Telephony functionality.

433

434 Due to lack of substantial feedback, EPA is not proposing any further changes to the following
435 allowances: **AVP, HD, UHD, and Transcoding**. The adder allowances provided for these features were
436 subtracted from the TEC of the models (unless they were 0 kWh/yr), and the allowances for the remaining
437 adders were determined through regression analysis, which contrasted remaining energy consumption of
438 each model, and distributed it according to the reported adders. Although EPA performed the regression
439 analysis across different combinations of VA and ENERGY STAR data and base types, the results from
440 the combined VA and ENERGY STAR datasets, including Cable, Satellite, and MVPD IP STBs, had the
441 largest number of significant results, due to the larger number of models in the sample and greater
442 variation between them. (As a counter-illustration, regression analysis of just the Thin Clients did not
443 provide much information on the allowances, since all Thin Clients have HNI and few other adders). A
444 discussion of the results for each adder is included below.

445

446 The regression analysis also provided estimates for each base allowance. However, these estimates
447 were for an average model of each type; they were reduced to reflect the performance of leading
448 products of each type before being included in Table 2, above.

449

450 **CableCARD:** EPA's regression analysis again returned an allowance of 26 kWh for CableCARD.
451 In their comments on Draft 1, two stakeholders noted that most Cable STBs use only one CableCARD,
452 such that the full 26 kWh allowance should be provided for the first CableCARD, instead of splitting it
453 between the first and a potential second one, as is in the VA and as EPA proposed in Draft 1.

454

455 However, despite the overwhelming use of CableCARD, alternatives exist. To encourage use of these
456 alternatives, EPA proposes to retain the 15 kWh allowance, thereby providing an incentive for
457 manufacturers to move to more efficient alternatives.

458

459 **HNI:** The regression analysis recommended an allowance of 35 kWh/yr for DVR, which is close to the
460 previously proposed 36 kWh/yr. EPA has made this slight update in Table 3.

461

462 **Multi-room:** The regression recommended an allowance of 21 kWh/yr for Multi-room, which is lower than
463 was proposed in Draft 1 and Version 4.1; however, the restored Multi-stream allowance is expected to
464 allow Multi-room boxes to qualify.

465

466 **Multi-stream:** Per stakeholder feedback that Multi-stream functionality is sometimes used independently
467 of DVR or Multi-room to provide picture-in-picture, EPA is proposing to bring back the Multi-stream
468 allowance. The regression revealed that 18 kWh/yr can be attributed to Multi-stream for Cable and
469 Satellite STBs. The parallel result for MVPD IP STBs was not significant; however, as EPA expects the

470 functions to be comparable, the Agency is also proposing an updated allowance of 18 kWh/yr.

471 3.3.2 **Client Only Incentive:** Multi-room STBs with a local display can receive an incentive for use in
472 Equation 1 by going into a lower-power state while continuing to provide video to their connected
473 clients, as calculated in Equation 3.

474 **Equation 3: Calculation of Client Only Incentive for Multi-room STBs**

475
$$Incentive_{CLIENT_ONLY} = \frac{P_{WATCH_TV} - P_{CLIENT_ONLY}}{P_{WATCH_TV}},$$

476 *Where:*

- 477 ▪ *Incentive_{CLIENT_ONLY} is the Client Only Incentive applicable to Multi-room*
- 478 *STBs;*
- 479 ▪ *P_{WATCH_TV} is the measured power in On Mode (W) for Multi-room STBs; and*
- 480 ▪ *P_{CLIENT_ONLY} is the Sleep Mode Power as measured in the Test Method.*

481 **Note:** As noted above, EPA has clarified that the Client-only Incentive only applies to Multi-room STBs
482 with a local display (i.e., non-DVGs).

483
484 Note: Products intended for sale in the US market are subject to minimum toxicity requirements. Please
485 see ENERGY STAR Program Requirements for Set-top Boxes: Partner Commitments for details.
486

487 **4 TESTING**

488 **4.1 Test Methods**

489 4.1.1 Test methods identified in Table 4 shall be used to determine energy consumption.

490 **Table 4: Test Methods for ENERGY STAR Qualification and Additional Incentives**

Product Type	Test Method
STBs	ENERGY STAR Test Method for Set-top Boxes (Rev. TBD)

491

492 **4.2 Certification Options**

493 4.2.1 ENERGY STAR requirements must be met in a Set-top Box's as-deployed configuration,
494 connected to the specific service providers network or a simulated live network specific to the
495 certifying service provider. ENERGY STAR Partner must report the most consumptive results for
496 the model. The reported value may exceed the tested value.

497 4.2.2 If a Partner wishes to certify configurations of a model for which non-ENERGY STAR certified
498 alternative configurations or operating scenarios exist, the Partner must assign the certified
499 configurations an identifier in the model name/number that is unique to ENERGY STAR certified
500 configurations. This identifier must be used consistently in association with the certified
501 configurations in marketing/sales materials and on the ENERGY STAR list of certified products
502 (e.g. model A1234 for baseline configurations and A1234-ES for ENERGY STAR certified
503 configurations).

504 **Note:** As a reminder, the above requirements to test STBs in the as-deployed configuration also apply to
505 single-room versus multi-room configuration, such that multi-room-capable ENERGY STAR labeled STBs
506 are expected to be deployed in certified configurations. If a particular configuration does not meet, it may
507 be identified as a separate model, per Section 4.2.2.

508 **5 USER INTERFACE**

509 5.1.1 Partners are encouraged to design products in accordance with the user interface standard IEEE
510 P1621: Standard for User Interface Elements in Power Control of Electronic Devices Employed in
511 Office/Consumer Environments. For details, see <http://energy.lbl.gov/controls/>.

512 **6 EFFECTIVE DATE**

513 6.1.1 Effective Date: The Version 5.0 ENERGY STAR Set-top Box specification shall take effect at
514 noted in the below Table 5. To qualify for ENERGY STAR, a product model shall meet the
515 ENERGY STAR specification in effect on its date of manufacture. The date of manufacture is
516 specific to each unit and is the date on which a unit is considered to be completely assembled.

517 **Table 5: Specification Effective Dates**

Base Type	Effective Date
Cable, CableDTA, Satellite, MVPD IP, OTT IP	January 1, 2017
Thin Client	January 1, 2018

518
519 6.1.2 Future Specification Revisions: EPA reserves the right to change this specification should
520 technological and/or market changes affect its usefulness to consumers, industry, or the
521 environment. In keeping with current policy, revisions to the specification are arrived at through
522 stakeholder discussions. In the event of a specification revision, please note that the ENERGY
523 STAR qualification is not automatically granted for the life of a product model.